MX-63-114B

TECHNICAL MANUAL

OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN

RADIO SET AN/PRC-126
MAGNAVOX PART NO. 707608-821

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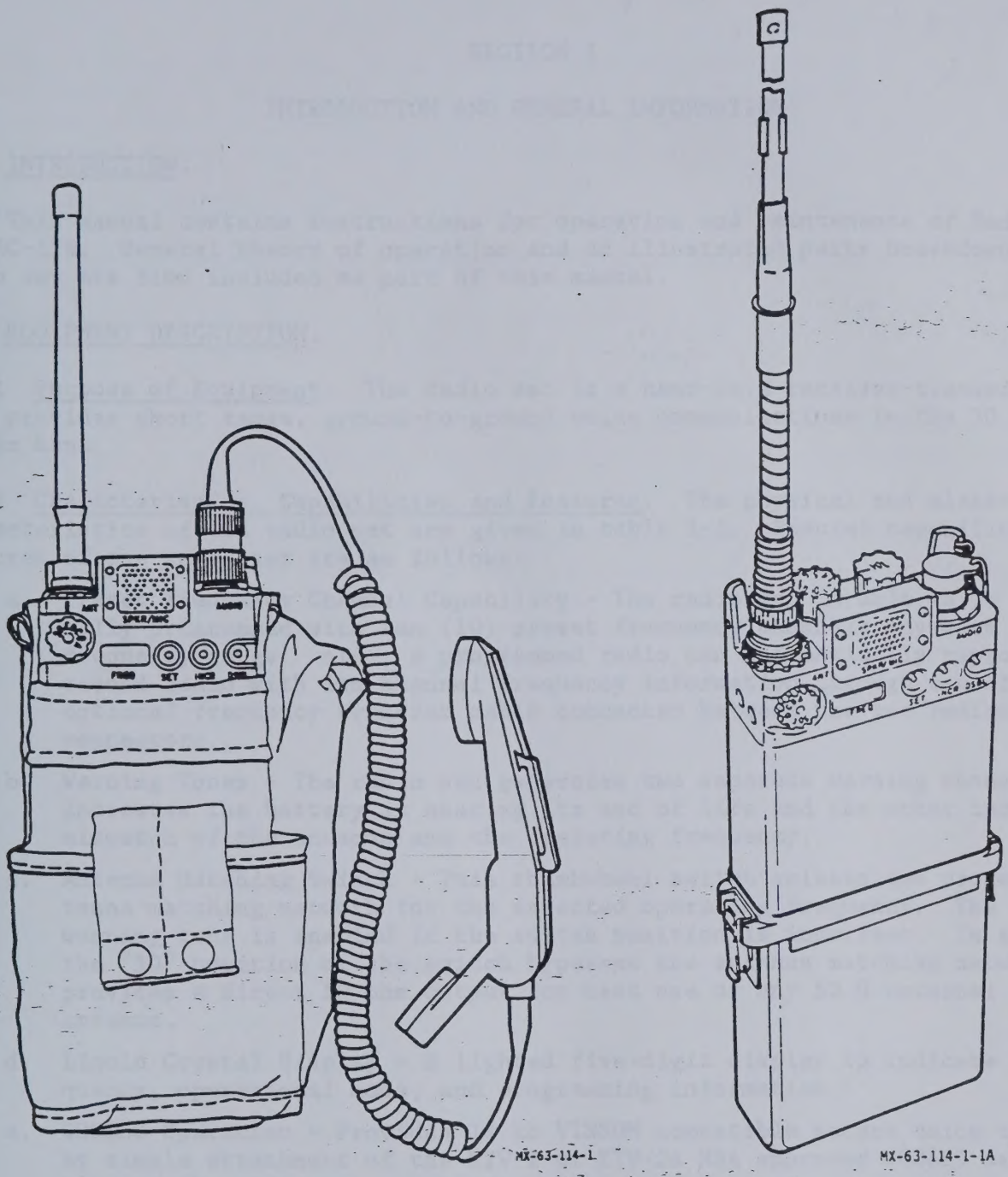
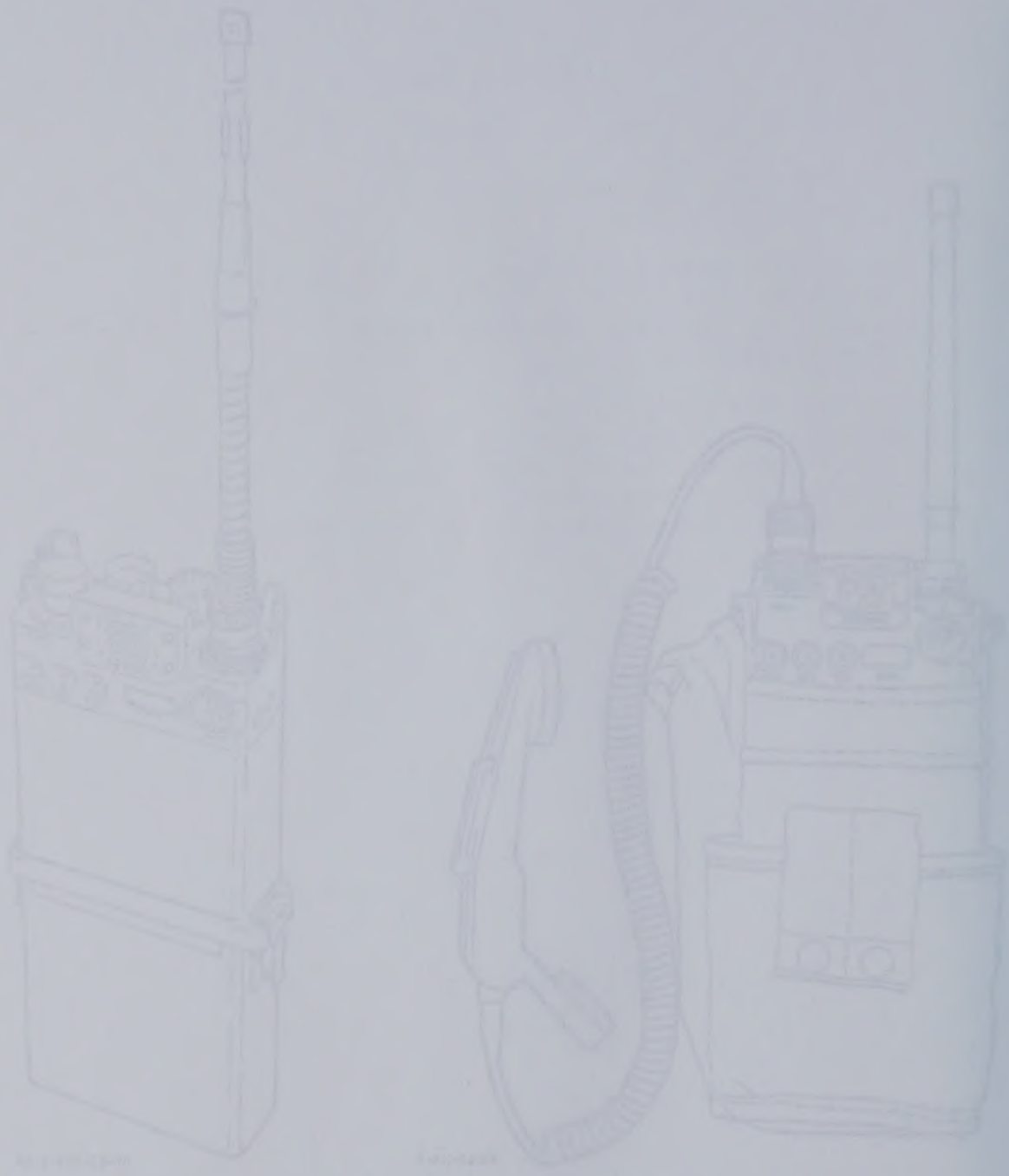


Figure 1-1. Radio Set AN/PRC-126



SECTION I

INTRODUCTION AND GENERAL INFORMATION

1-1 INTRODUCTION.

This manual contains instructions for operation and maintenance of Radio Set AN/PRC-126. General theory of operation and an illustrated parts breakdown for the radio set are also included as part of this manual.

1-2 EQUIPMENT DESCRIPTION.

1-2.1 Purpose of Equipment. The radio set is a hand-held receiver-transmitter that provides short range, ground-to-ground voice communications in the 30 MHz to 88 MHz band.

1-2.2 Characteristics, Capabilities and Features. The physical and electrical characteristics of the radio set are given in table 1-1. Special capabilities and features of the radio set are as follows:

a. Preset Frequency Channel Capability - The radio set is able to be externally programmed with ten (10) preset frequency channels anywhere in the frequency range. Also, a programmed radio can automatically reprogram a second radio with its channel frequency information through use of an optional frequency transfer cable connected between the two radios' AUDIO connectors.

b. Warning Tones - The radio set generates two separate warning tones; one indicates the battery is nearing its end of life and the other indicates a mismatch of the antenna and the operating frequency.

c. Antenna Matching Switch - This thumbwheel switch selects the proper antenna matching network for the selected operating frequency. The antenna warning tone is enabled if the switch position is incorrect. In addition, the "50" position of the switch bypasses the antenna matching networks and provides a direct 50 ohm output for test use or any 50 Ω external antenna.

d. Liquid Crystal Display - A lighted five-digit display to indicate frequency, operational mode, and programming information.

e. COMSEC Operation - Provides 16 kb VINSON compatible secure voice operation by simple attachment of the KYV-2 or KYV-2A NSA approved COMSEC device between the radio set and battery.

f. Half-duplex Operation - The radio set is capable of half-duplex operation (receive/transmit on separate frequency at separate time).

1-2.3 List of Major Components. Figure 1-1 shows the major components of the radio set. The radio set consists of: the rt unit, which contains the two modules, battery case and all necessary operating controls and connectors; the two antennas, the carrying bag, and handset. The unused antenna or both can be stored in the carrying bag.

NOTE

The battery is GFP and snaps onto mating connectors on the bottom of the RT unit as shown in figure 1-2. The battery case then retains the battery and is held on by two latches. A spare battery can be stored in the carrying bag.

1-3 AVAILABLE ACCESSORIES, OPTIONS.

The following accessories are available for field use with the radio set.

a. Batteries - Standard - BA-5588/U Lithium
- Optional - BA-1588/U Mercury
- BB-588/U Ni-Cad

b. Cold Weather Cable - Magnavox Part No. 56xxxx-801 - Used to connect battery to RT when mounting battery under clothing during extreme cold weather conditions.

c. Frequency Transfer Cable - Magnavox part no. 568698-801 - Can be used to transfer frequency programming data between two radio sets, if desired.

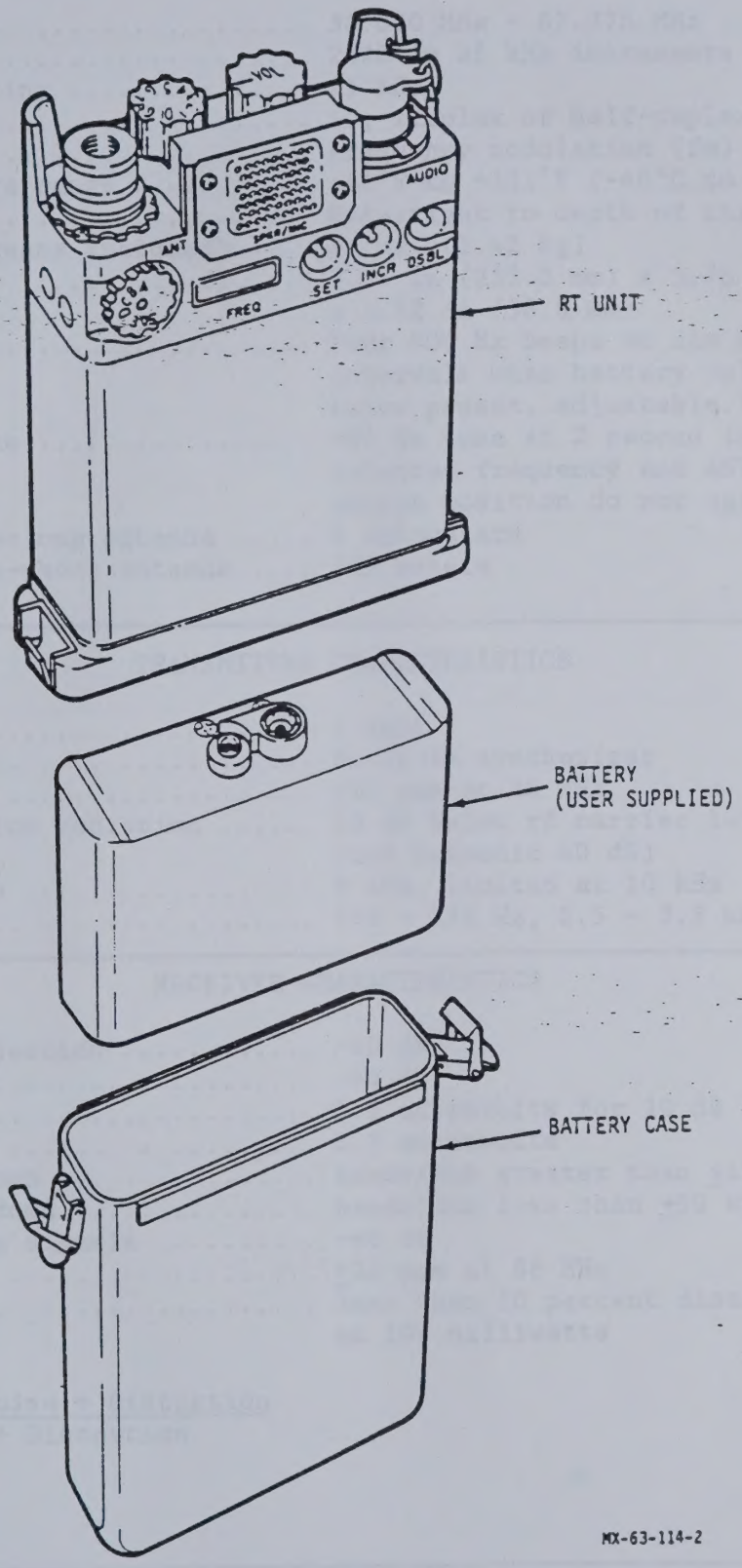


Figure 1-2. Battery Installation

Table 1-1. Table of Specifications

GENERAL CHARACTERISTICS	
Frequency range	30.000 MHz - 87.975 MHz
Available channels	2320 in 25 kHz increments
Minimum Channel spacing	25 kHz
Preset channels	10; simplex or half-duplex
Modulation	Frequency modulation (fm)
Operating temperature range	-40°F to +131°F (-40°C to +55°C)
Moisture resistance	Watertight to depth of three feet
Weight (battery, antenna included)	50 oz. (1.42 kg)
Size	9.97 in (253.2 mm) x 3.78 in (96.0 mm) x 1.52 in (38.6 mm)
Low battery tone	Four 400 Hz beeps at six second intervals when battery voltage drops below preset, adjustable level
Antenna mismatch tone	400 Hz tone at 2 second intervals when selected frequency and ANT match switch position do not agree
Communications range-long antenna	3 kilometers
Communications range-short antenna	500 meters

TRANSMITTER CHARACTERISTICS	
Power output	1 watt
Frequency control	Built-in synthesizer
Frequency stability	±25 ppm at 88 MHz.
Spurious and harmonics radiation	50 dB below rf carrier level (2nd harmonic 40 dB)
Modulation deviation	8 kHz, limited at 10 kHz
Squelch tone	148 - 152 Hz, 2.5 - 3.5 kHz deviation

RECEIVER CHARACTERISTICS	
Adjacent channel rejection	-60 dB
Image rejection	-40 dB
Sensitivity	0.3 microvolts for 10 dB SINAD*
Squelch sensitivity	0.3 microvolts
Selectivity, 6 dB down	bandwidth greater than ±13 kHz
60 dB down	bandwidth less than ±50 kHz
Response to spurious signals	-60 dB
Frequency stability	±25 ppm at 88 MHz
Audio output	less than 10 percent distortion at 100 milliwatts

*SINAD = $\frac{\text{Signal + Noise + Distortion}}{\text{Noise + Distortion}}$

1-4 LIST OF EXPENDABLE ITEMS.

Table 1-2 lists expendable supplies and materials that may be required during operation and maintenance of the radio set.

Table 1-2. Expendable Items List

Item	Quantity	Description	Stock Number
1	1 ea.	Brush	8020-00-721-9657
2	1 yd.	Cloth	8305-00-222-2423
3	8 oz.	Paint	TBD
4	1 sh.	Sandpaper	TBD
5	2 oz.	Silicone grease	6850-00-177-5094
6	1 gal.	Solvent (trichlorotrifluoroethane)	6850-00-984-5853
7	1 gal.	Thinner	TBD

SECTION II

PREPARATION FOR USE AND INSTALLATION

2-1 INTRODUCTION.

This section contains instructions to prepare the radio set for use, installation instructions and instructions to prepare the radio set for storage or shipment.

2-2 UNPACKING AND INSPECTION.

This radio set was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order. Upon receipt, inspect the radio set as follows:

a. During unpacking, inspect the radio set for physical damage that may have occurred during shipment. If the equipment has been damaged, report the damage on DD Form 6, Packaging Improvement Report.

b. Check the radio and supplied accesories against the packing slip to ensure the shipment is complete.

c. Test the electrical performance of the radio set using the procedures outlined in Section V of this manual.

2-3 PREPARATION FOR USE.

Perform the following installation procedures as required to prepare the radio set for use.

2-3.1 Antenna Installation. Install the antenna on the radio set ANT connector by turning it fully clockwise (finger tighten only).

2-3.2 Handset Installation. To operate the radio set with a standard handset, line up the keyway (groove) of the handset connector with the keyway of the AUDIO connector and press down firmly. Lock the connector by turning it fully clockwise. When this is done, the internal SPKR/MIC is disconnected.

2-3.3 Battery Installation. To install a battery in the radio set, perform the following steps:

a. Unfasten latches on battery case; remove battery case and old battery (if installed). (Handle case carefully as damaged case will not seal properly.)

NOTE

Ensure the Secure Voice Module (SVM) shorting plug (located next to the battery terminal connector in the RT unit), is installed in good condition. The radio set will not work unless the shorting plug or an SVM is installed.

b. Plug battery into mating connector on rt unit.

c. Apply a thin coat, if desired, of silicone grease (item 5, table 1-2) to the top edge of the battery case.

d. Replace battery case and secure with the two latches.

2-3.4 Secure Voice Module Installation. Secure voice operation may be utilized on the radio set by connecting the SVM to the bottom of the rt unit. To install the SVM in the radio set, perform the following steps:

a. Unfasten latches on battery case and remove the battery case and battery.

b. Unplug the SVM shorting plug and store in cavity provided in bottom of module cover.

c. Apply a thin coat of silicone grease (item 5, table 1-2) to top edge of the SVM cover.

d. Install SVM onto bottom of rt unit, ensuring connectors are properly aligned. Secure SVM to rt unit with the two latches.

e. Plug battery into mating connector on bottom of SVM.

f. Apply a thin coat of silicone grease (item 5, table 1-2) to the top edge of the battery case.

g. Replace battery case and secure with the two latches.

2-4 PREPARATION FOR RESHIPMENT.

2-4.1 Repackaging For Storage Or Shipment. Refer to figure 2-1 to prepare the radio set for storage or shipment. Markings shall be applied in specified area (item 9, figure 2-1) and in accordance with requirements. When items are to be stored for prolonged periods, bagged desiccant and a humidity indicator card (items 3 and 4, figure 2-1) can be included for moisture protection.

2-4.2 Administrative (Short Term) Storage. Administrative storage covers storage of equipment which can be readied for mission performance within 24 hours. Before placing an item in administrative storage, the next scheduled preventive maintenance checks and services should be performed, all known deficiencies corrected, and all current modification work orders applied. The administrative storage site should provide required protection from the elements and allow access for visual inspection and exercising when applicable.

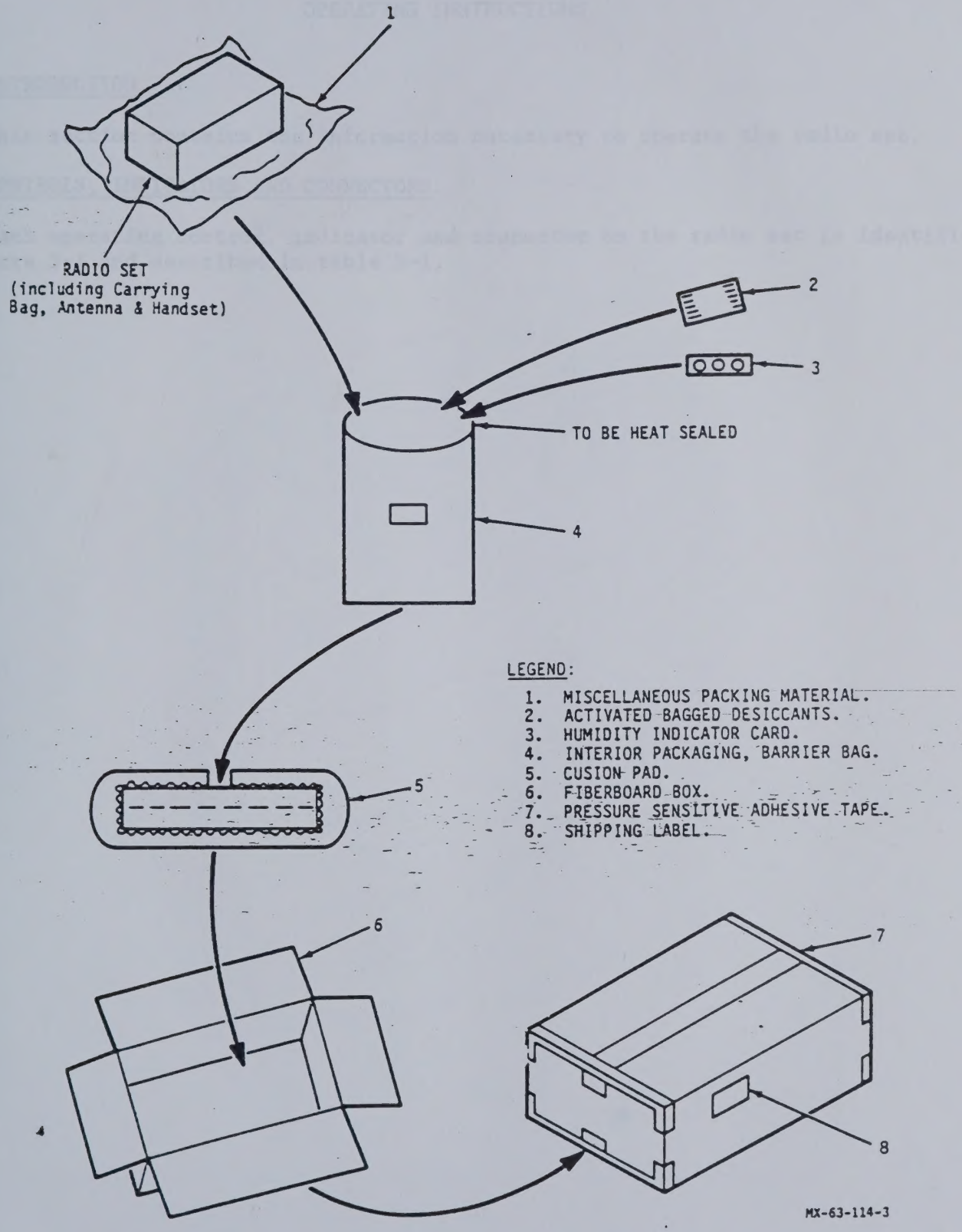
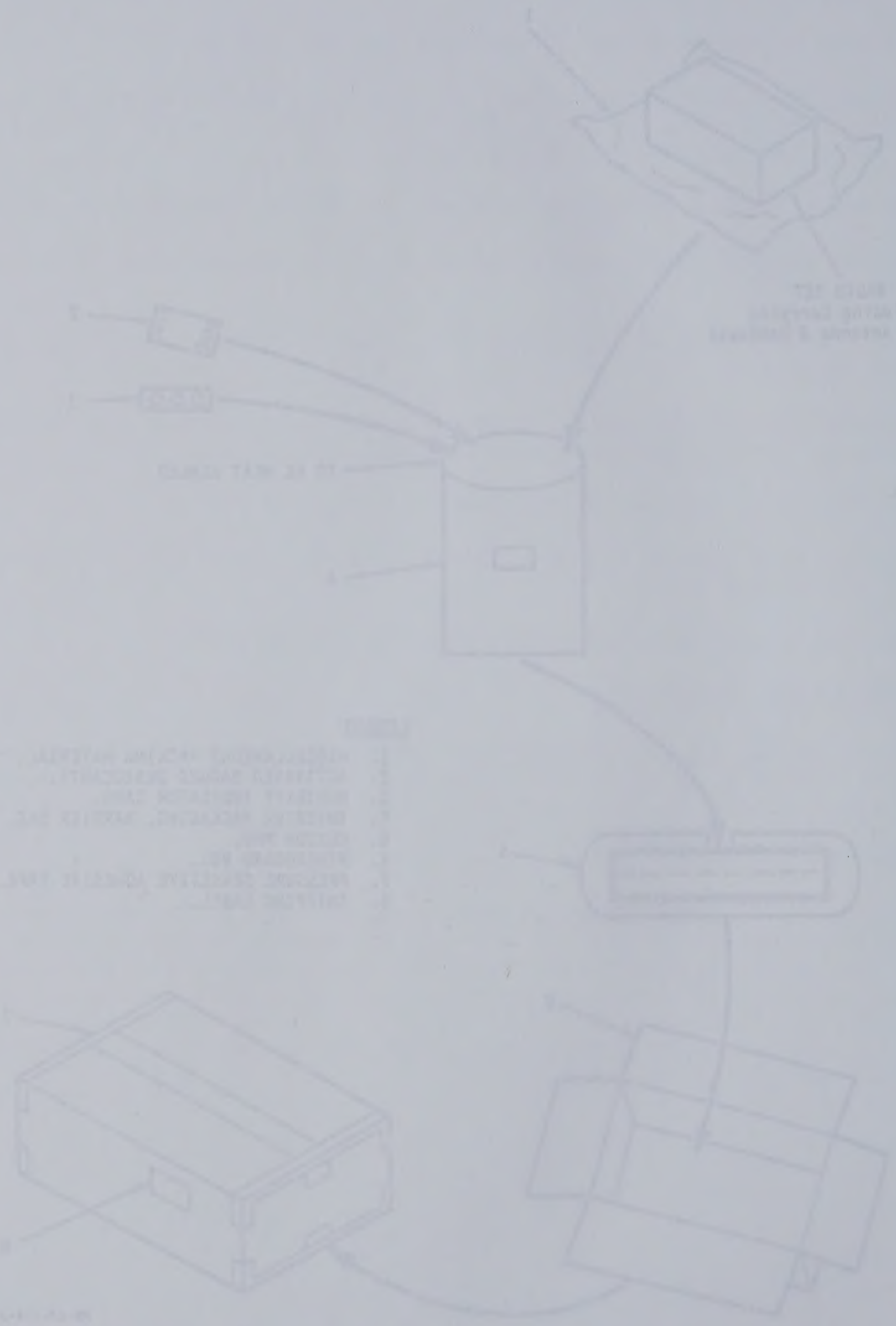


Figure 2-1. Radio Set Packaging Diagram



SECTION III

OPERATING INSTRUCTIONS

3-1 INTRODUCTION.

This section contains the information necessary to operate the radio set.

3-2 CONTROLS, INDICATORS AND CONNECTORS.

Each operating control, indicator and connector on the radio set is identified in figure 3-1 and described in table 3-1.

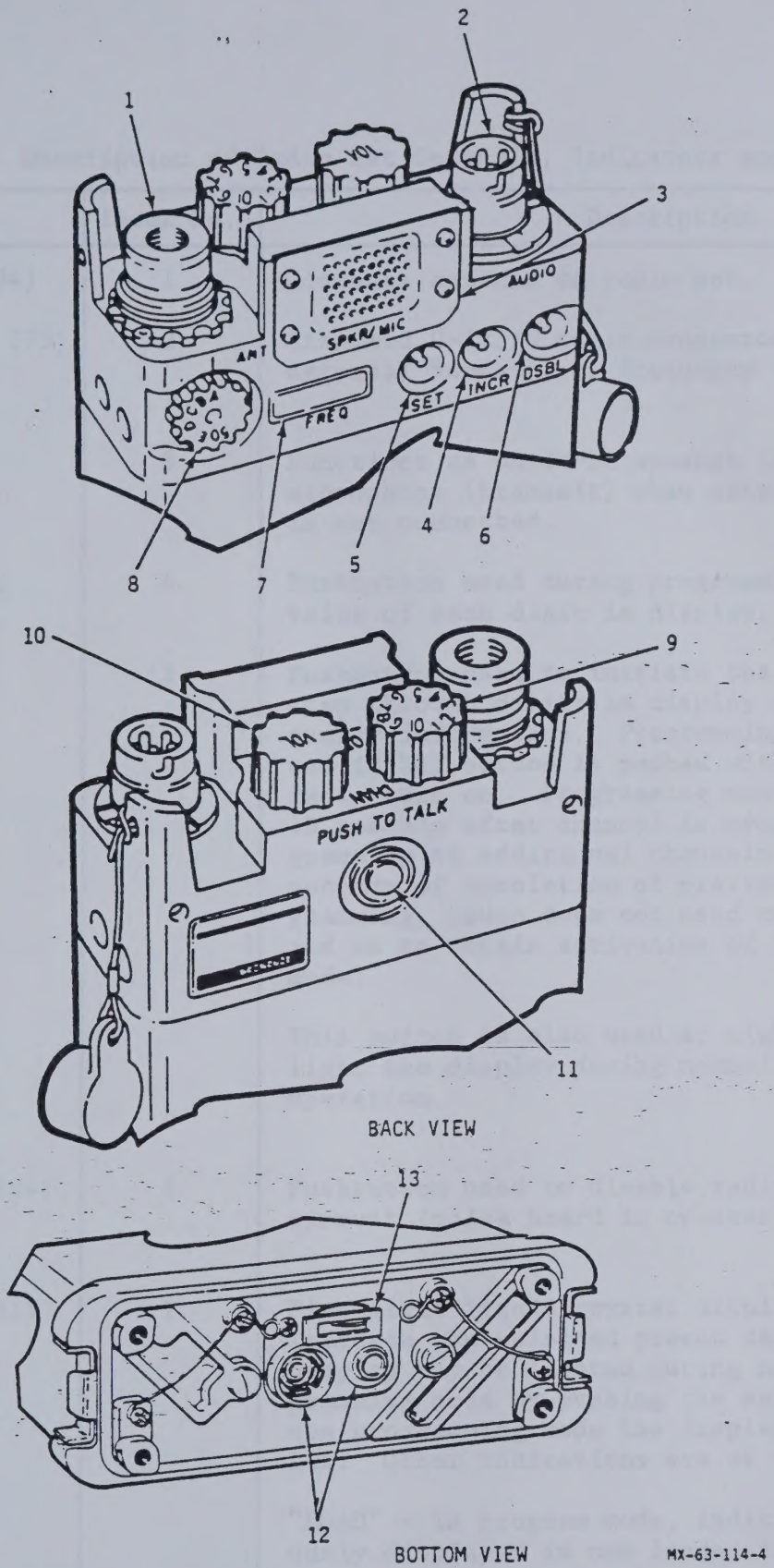


Figure 3-1. Radio Set Controls, Indicators and Connectors

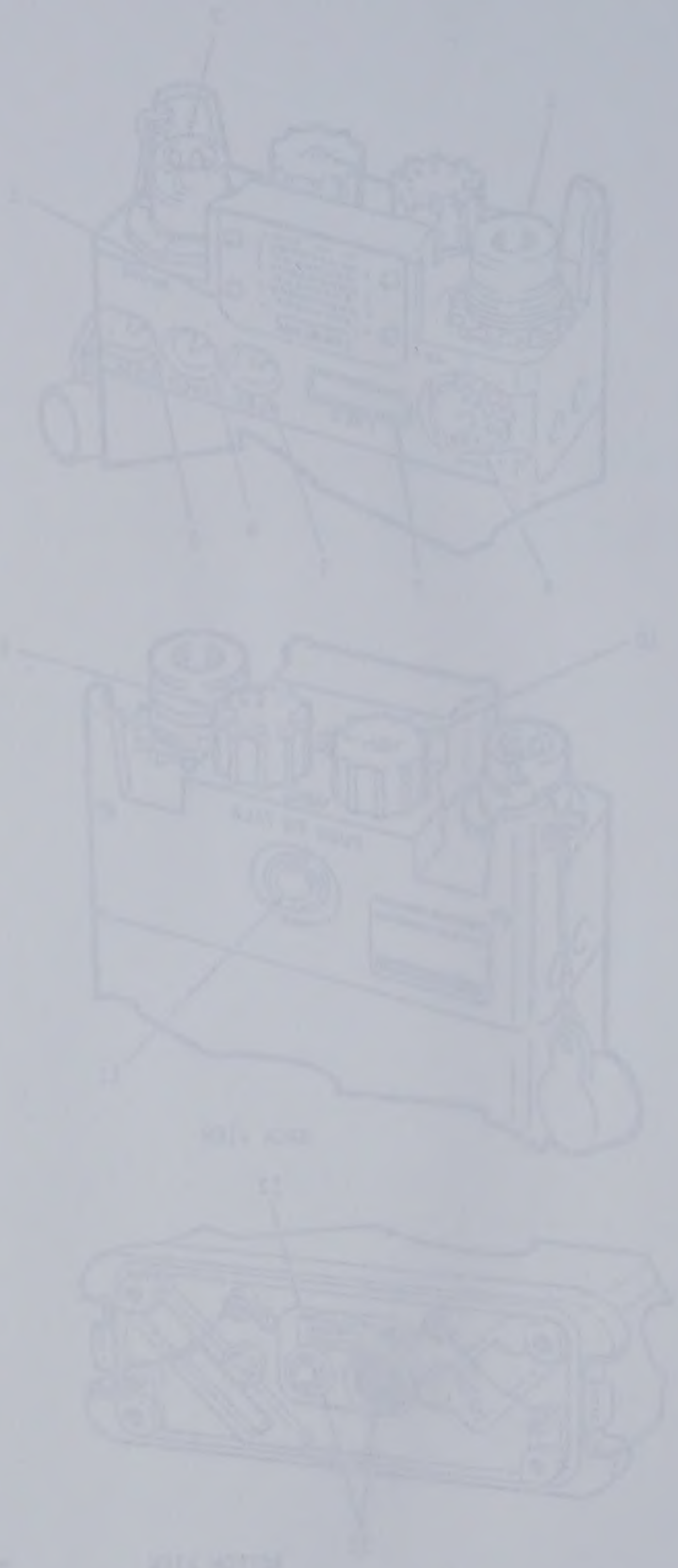


Table 3-1. Description of Radio Set Controls, Indicators and Connectors

Name	Index No.	Description
ANT connector (J4)	1	Connects antenna to radio set.
AUDIO connector (J5)	2	Standard U-183/U style connector for use with external handset, or frequency transfer cable.
SPKR/MIC (LS1)	3	Functions as built-in speaker (receive) and microphone (transmit) when external handset is not connected.
INCR switch (S9)	4	Pushbutton used during programming mode to set value of each digit in display.
SET switch (S8)	5	Pushbutton used to initiate the programming mode, step through digits in display and load new frequency information. Programming mode is activated if SET button is pushed within 10 seconds of radio turn on. Programming mode is deactivated 10 seconds after channel is programmed. If programming of additional channels starts within 10 seconds of completion of previous channel's programming, radio does not need to be turned off and on to retain activation of the programming mode. This switch is also used at night to momentarily light the display during normal (non-programming) operation.
SQ DSBL switch (S4)	6	Pushbutton used to disable radio set squelch circuit (noise heard in speaker).
FREQ display (DS1)	7	Five-digit liquid crystal display (LCD) used to indicate the selected preset channel frequency. Display may be lighted during normal (non programming mode by pushing the set button. During the programming mode the display is continuously lit. Other indications are as follows: "LOAD" - In program mode, indicates data previously displayed is now loaded in the selected preset channel memory location. "FILL" - During frequency transfer, (when using the optional frequency transfer cable) indicates radio set is ready to send or accept program data.

Table 3-1. Description of Radio Set Controls, Indicators and Connectors-Continued

Name	Index No.	Description
ANT match switch (S5)	8	Selects proper antenna matching network for the operating frequency selected or bypasses antenna matching networks to provide a direct 50 ohm output. Warning tone sounds in speaker if match is incorrect. Corresponding frequencies for each switch position are as follows: A = 30-36 MHz B = 36-46 MHz C = 46-54 MHz D = 54-64 MHz E = 64-88 MHz 50 = 50 ohms output
		NOTE A DC path to ground of 2000 ohms or less must be provided between the antenna terminal and ground when transmitting or receiving in the 50 ohm output position. If the antenna does not provide this DC path, an external path must be provided with an RF impedance greater than 1000 ohms.
CHAN selector switch (S3)	9	Selects one of 10 preset operating channels. In programming mode, selects channel to be loaded.
VOL/OFF switch (S2)	10	Turns radio set on (clockwise) or off (full counterclockwise). Adjusts level of sound heard in radio set or handset speaker.
PUSH TO TALK switch (S1)	11	Enables radio set to transmit when pressed.
Battery connectors	12	Connects battery to radio set.
SVM connector (J1) and shorting plug (P1)	13	Provides interconnection between SVM and radio set. Shorting plug allows radio set to operate when SVM is not installed.

3-3 PREVENTIVE MAINTENANCE CHECKS.

To ensure the radio set is always ready for operation, it must be inspected so that defects may be discovered and corrected before they result in serious damage or failure. Table 3-2 describes the operator's preventive maintenance checks for the radio set and includes what items should be checked, how to check them and at what intervals ((B) before, (D) during and/or (A) after operation) the checks are to be made. Routine checks like cleaning, checking for frayed cables, stowing items not in use, covering unused receptacles and checking for loose nuts and bolts are not listed as checks. They are things that you should do anytime you see they must be done.

Table 3-2. Operator Preventive Maintenance Checks

B - Before Operation D - During Operation A - After Operation					
Interval			Item to be Inspected	Procedures check for and have repaired or adjusted as necessary	Equipment is not ready/ available if:
B	D	A			
*	*		Antenna	Check that antenna is not broken and is mated with ANT connector on radio set. ANT match switch is in proper position.	Antenna broken, antenna missing, antenna will not mate with the ANT connector.
*			Operating Controls	Check that control knobs are not missing or loose on shaft and that they operate smoothly without binding.	Operating control knobs are missing or binding.
*			Handset	Check that handset connector mates properly with AUDIO connector on radio set. Check condition of handset.	Handset connector will not mate with AUDIO connector. Handset case cracked or frayed cable.
*	*	*	Batteries	With radio set turned on - check for low battery alarm.	Battery alarm sounds and replacement battery is not available.
*	*		Display	With radio set turned on - check for frequency on FREQ display.	Frequency not present on FREQ display.
*	*		Operation	With radio set turned on - Set radio set to an assigned channel, communicate with a distant radio set or station.	You can not make proper contact with distant station or radio set.
		*	Radio Set	Check the following for damage: case, fasteners, knobs, connectors, display.	Damage to items that may cause the radio set not to perform properly.

3-4 NORMAL OPERATION.

3-4.1 Turn On Procedure. This procedure tells you how to turn on the radio set for operation. Refer to figure 3-1 as necessary to locate all operator controls and indicators.

a. Turn the OFF/VOL control full clockwise. After a few seconds the display shows the preset frequency for the selected channel.

b. If desired, refer to paragraph 3-4.2 and load preset frequencies.

c. If half-duplex operation is desired, refer to paragraph 3-4.3 and load transmit offset frequencies.

d. Set CHAN switch to desired channel number. Display again shows the preset frequency for the selected channel.

e. After channel selection is made, a warning tone is heard if ANT match switch is not in correct position. Adjust ANT match switch to position which disables warning tone.

f. Press and hold the SQ DSBL pushbutton. Adjust the VOL control for desired listening level. Release SQ DSBL pushbutton to disable speaker noise.

g. The radio set is now ready to operate.

3-4.2 Channel Reprogramming. This procedure tells you how to load preset channel frequency information into the radio set memory.

a. Turn off radio, and then turn radio back on.

b. Set CHAN switch to the channel number to be reprogrammed.

c. Within 10 seconds of radio turn on press SET button momentarily. Radio set is now in program mode. The display indicates the left-most digit of desired frequency.

d. Press INC button until proper number is displayed.

e. Press SET button momentarily. The next digit to the right is displayed.

f. Repeat steps d. and e. until all digits are set to the proper frequency.

NOTE

The fourth and fifth digits of the frequency display increment in 25 kHz steps.

g. Press SET button momentarily. "LOAD" is displayed. Channel is now loaded.

h. Within 10 seconds repeat steps b. through h. to reprogram other channels.

NOTE

If more than 10 seconds lapses before new channel programming is started, turn radio off and back on, start programming within 10 seconds.

3-4.3 Transmit Offset Frequency Programming. This procedure tells you how to load preset transmit offset frequencies into the radio set memory. These frequencies are used during transmit for half-duplex operation.

a. Perform steps a. through f. of paragraph 3-4.2 for the desired transmit offset frequency.

b. Press the PUSH TO TALK button and, while holding it down, press the SET button momentarily. "LOAD" is displayed. Release the PUSH TO TALK button. The transmit offset frequency for the selected channel is now loaded.

NOTE

The radio set normally displays the receive frequency used during half-duplex operation. To display the transmit frequency, press the PUSH TO TALK button.

c. Repeat steps a. and b. as necessary to program other transmit offset frequencies.

3-4.4 Channel Reprogramming Using The Frequency Transfer Cable. This procedure explains how to load preset channel frequency information from a master radio set into a second radio set using the optional frequency transfer cable.

a. Refer to paragraphs 3-4.2 and 3-4.3 as required and load the desired frequencies into the designated master radio set.

b. Turn the OFF/VOL control on both radio sets to OFF.

c. Remove handsets (if used) from both radio set AUDIO connectors and connect frequency transfer cable between the two AUDIO connectors.

d. Turn both radio sets on. Both radio displays will indicate FILL and both will have squelch defeated (receiver noise present in SPKR/MIC).

e. Press the master radio set PUSH TO TALK button to start the data transfer.

f. Frequency transfer is complete when both radios become squelched and the master radio set displays a frequency.

g. Turn the OFF/VOL control on both radio sets to OFF.

h. Remove frequency transfer cable and install handsets (if used).

i. Turn both radio sets on and check channel 6 to verify frequency transfer.

3-5 EMERGENCY OPERATION.

3-5.1 Jamming. A very strong signal on the same frequency that your radio is on can make it impossible to hear incoming messages on your radio set. This is referred to as JAMMING. If jamming is suspected, try the following:

a. Disconnect your radio's antenna; if noise is still present in speaker, you have a defective radio set.

b. Report the interference to your superior officer immediately.

c. Change your position (if possible); try to use a nearby obstruction as a screen. This may help.

d. Adjust your VOL control; you may be able to hear over the noise.

e. As a last resort, ask for a change to another channel and call sign.

3-6 DEGRADED CHANNELS.

As a result of spurious signals generated in the frequency synthesizing process, receive sensitivity may be slightly reduced on certain frequencies. Table 3-3 is a listing of these frequencies. Most of the frequencies still meet the service condition limits. Some minor variation, set to set, in the severity of this reduction can be expected, however, only the frequencies so identified by an * in table 3-3 have been found to occasionally degrade beyond services condition limits.

Table 3-3. Radio Set Channels (Frequencies-kHz) with Reduced Sensitivity

46075	69875	
47075	69925	
50675	71675	*Frequencies with receiver sensitivity reduction below service condition limits. --Potential Degraded Channels.
54650	76375 *	
54675	76400 *	
61425	76425 *	
61450	76450 *	
64175	76475	
64200	76500	
64225	76800 *	
66550	79350	
66575	81925	
69850	83925 *	

SECTION IV

THEORY OF OPERATION

4-1 INTRODUCTION.

This section contains the basic principles of circuit operation for the radio set. The information is first discussed in a simplified block diagram description (figures 4-1, 4-2) and then in a detailed block diagram description (figures 4-3, 4-4, and 4-5).

4-2 OVERALL DESCRIPTION.

The radio set consists of a frame and panel assembly, two plug-in modules and the battery case. The panel assembly contains the connectors, switches, speaker/mic and frequency display necessary for operation of the radio set. The two plug-in modules contain all the circuitry necessary for channel frequency programming, frequency synthesis, receive operation and transmit operation. These functions are further described below.

4-3 BLOCK DIAGRAM DESCRIPTION.

4-3.1 Channel Frequency Programming. The radio set provides for operator selection of ten independent preset channels in the 30 to 88 MHz vhf band. The selected channel frequency is displayed on the liquid crystal (LCD) display. In addition, a transmit offset frequency for duplex operation can also be programmed for each of the ten preset channels. Manual channel frequency programming is accomplished with the SET, INCrement switches, the CHAN switch, and the PUSH TO TALK switch. The radio set can also be automatically programmed through the external program data input on the AUDIO connector. A microcontroller data processor and a nonvolatile programmable memory (EEPROM) are used to provide the independent preset channels capability.

4-3.2 Frequency Synthesis. The frequency synthesizer section of the radio set generates a stable injection frequency for the transmit and receive mixers. The synthesizer frequency range is from 51.4 MHz to 109.4 MHz in 25 kHz increments. The required frequency accuracy and stability is achieved by phaselocking a variable frequency (51.4 to 109.4 MHz) voltage controlled oscillator (VCO) to a fixed frequency standard (6.4 MHz), crystal-controlled reference oscillator. The channel frequency of the synthesizer is determined by the digital data from the microcontroller and preset channel memory.

4-3.3 Receiver Operation (Fig. 4-1). When the radio set is turned on (VOL/ OFF switch is turned CW), the unit is in the receive mode (squelch is on, no receiver noise present). Signals entering the antenna are routed through the antenna matching networks and harmonic filters to the converter stage (RF amplifiers and first mixer). The frequency synthesizer provides the injection frequency for the first mixer. The output of the mixer is the difference product of 21.4 MHz (first IF) obtained by mixing the incoming signal (30 to 88 MHz) with the 51.4 to 109.4 MHz injection frequency. A 21.4 MHz IF amplifier and a crystal filter provide a channel bandwidth of $\pm$15 kHz and greater than 40 dB attenuation to adjacent channels.

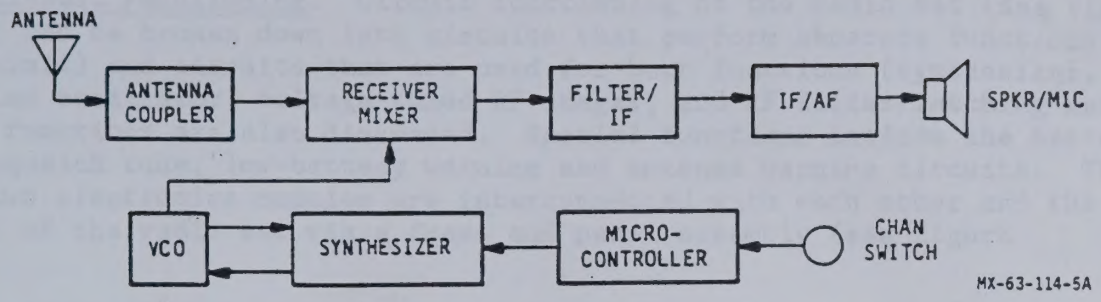


Figure 4-1. Receiver Operation, Simplified Block Diagram

The 21.4 MHz signal is amplified and converted to 455 kHz (second IF) in the filter/IF section. The second IF Filter provides over 40 dB of additional selectivity. The 455 kHz signal is amplified, limited, and applied to an FM quadrature detector for demodulation. The audio output from the detector is filtered and amplified in the AF section and routed to the internal speaker/microphone or external handset.

4-3.4 Transmitter Operation (Fig. 4-2). When the radio set is in the transmit mode (unit turned on and PUSH TO TALK switch depressed), the speaker/microphone is used as a microphone to apply a voice signal to the modulation circuits. The speech signal is frequency modulated on a 21.4 MHz intermediate carrier signal (deviation oscillator) and applied to the transmit mixer along with the frequency synthesizer signal (51.4 to 109.4 MHz). The difference output signal from the mixer (30 to 88 MHz) is selected, filtered, and amplified by one of the two RF amplifiers and applied to the power amplifiers. The frequency modulation on the 21.4 MHz signal is transferred to the 30 to 88 MHz carrier signal by the mixing process. The power amplifiers increase the FM carrier signal to one watt nominal. The signal is then filtered and impedance matched by the antenna matching network to the antenna for radiation.

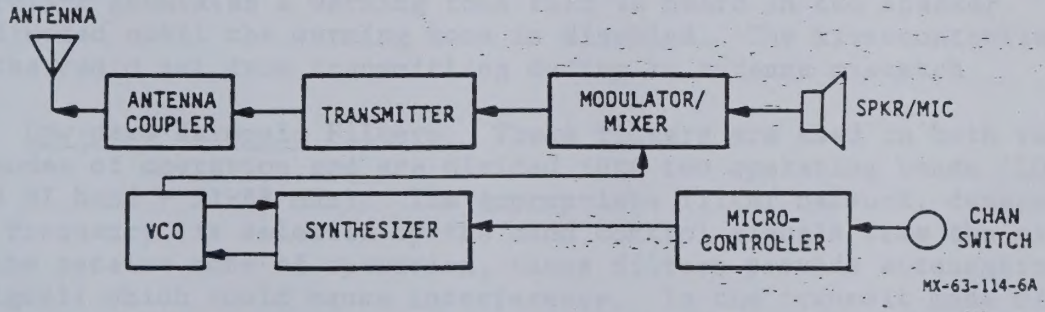


Figure 4-2. Transmitter Operation, Simplified Block Diagram

4-4 DETAILED CIRCUIT DESCRIPTION.

This section is limited to description of the modules and their interfacing with each other.

4-4.1 Circuit Functioning. Circuit functioning of the radio set (see figures 4-3 and 4-4) can be broken down into circuits that perform separate functions (receive and transmit) and circuits that are used for both functions (synthesizer, voltage-controlled oscillator, voltage-tuned RF stages, and RF filter/matching networks). Special functions are also discussed. Special functions include the battery saver, 150 Hz squelch tone, low-battery warning and antenna warning circuits. The circuits of the two electronics modules are interconnected with each other and the external features of the radio set via a frame and panel assembly (see figure 4-5).

4-4.2 Receive Operation. The receiver is packaged in both modules. The RF/IF module (figure 4-3) contains the RF, IF, FM detector, squelch, and wideband audio circuits. The SYNTH/AF module (figure 4-4) contains the narrowband audio circuits which include the speech filter, squelch gate, speaker/headphone amplifier, speaker mute. Receiver functions are discussed in the following paragraphs.

4-4.2.1 RF Section. The RF section includes the antenna matching networks, low-pass harmonic filters, diode switches, varactor tuned RF amplifiers, and the receiver first mixer.

4-4.2.1.1 Antenna Matching Networks. These networks provide optimum impedance matching and power transfer between the radio set antenna and the receiver or transmitter. The networks are divided into five operating bands of 30-36 MHz (A), 36-46 MHz (B), 46-64 MHz (C), 64-66 MHz (D) and 66-88 MHz (E) and are manually selected with the ANT match switch. A sixth position on the ANT match switch (50) is provided which bypasses all matching networks and allows for direct 50 ohm interface between the receiver or transmitter and an external 50Ω load. The 50 ohm input/output position is also used when troubleshooting or making performance measurements using bench test equipment and the test set. A DC path to ground of 2000 ohms or less must be provided between the antenna terminal and ground when transmitting or receiving in the 50 ohm output position. If the antenna does not provide this DC path, an external path must be provided with an RF iumpedance greater than 1000 ohms. The microcontroller monitors the position of this switch and compares its position with the selected frequency. If the switch is set to the wrong range, the microcontroller generates a warning tone that is heard in the speaker. The switch is then adjusted until the warning tone is disabled. The microcontroller also prevents the radio set from transmitting during an antenna mismatch.

4-4.2.1.2 Low-pass Harmonic Filters. These filters are used in both receive and transmit modes of operation and are divided into two operating bands (LO band - 30-51 MHz and HI band - 51-88 MHz). The appropriate filter network, depending on the operating frequency, is selected by the band control signals from the microcontroller. In the receive mode of operation, these filters provide attenuation to out-of-band signals which could cause interference. In the transmit mode of operation, the filters provide attenuation to the harmonic frequencies of the transmitter carrier frequency.

4-4.2.1.3 Diode Switches. Diode switches are used to couple RF signals from the antenna to the receiver RF amplifier, to couple the synthesizer VCO injection signal to the receiver first mixer, to couple RF signals from the transmit mixer to the RF amplifiers and antenna, to select one of two antenna harmonic filter bands,

to select one of two synthesizer VCO operating bands, to select one of two RF amplifier operating bands. These diodes are turned on by forward-bias current from the receive B+, chopped B+, transmit B+, HI band, LO band control lines depending on the operating frequency and mode.

4-4.2.1.4 RF Amplifier. This amplifier section consists of two bandswitched, varactor tuned RF amplifiers. The low band amplifier covers the frequency range from 30 MHz to 51 MHz and the high band amplifier covers the frequency range from 51 MHz to 88 MHz. The bandswitch and tuning voltages for both amplifiers are generated automatically by the synthesizer when a new frequency selection is made. The tuning voltage range is 1.8 Vdc to 9.5 Vdc. The gain of each amplifier is nominally 15 dB. The output from the RF amplifier is routed to the receiver first mixer. This amplifier section is also used in the transmit mode of operation to provide selectivity to undesired transmit mixer products. Transfer of operation is accomplished with diode switches.

4-4.2.1.5 First IF. This circuit consists of a passive, double-balanced, diode mixer, an IF amplifier and a 21.4 MHz crystal filter. The receiver first mixer translates the incoming, amplified RF signal to the first intermediate frequency (IF). This function is accomplished by mixing the RF signal with the synthesizer VCO signal. The synthesizer VCO frequency range of 51.4 MHz to 109.4 MHz provides high side injection to the first mixer (21.4 MHz above the RF signal). The first IF amplifier and a crystal filter select the difference product of 21.4 MHz and reject all other mixer products. The first mixer and IF amplifier provide a nominal conversion gain of 6 dB from RF to IF. The crystal filter provides a -6 dB pass bandwidth of 30 kHz and a -40 dB stop bandwidth of 100 kHz. The filter insertion loss is 2 dB. The total receiver gain to the input of the second IF section is 23 dB nominal.

4-4.2.2 Second IF. The second IF section consists of the second mixer, 21.855 MHz local oscillator, 455 kHz second IF amplifier, FM detector, and squelch functions. The active portions of these functions are contained within one integrated circuit.

4-4.2.2.1 Second Mixer. The receiver second mixer translates the 21.4 MHz IF to a second IF of 455 kHz by mixing the 21.4 MHz signal with a 21.855 MHz local oscillator and selecting the difference product of 455 kHz. A bandpass filter following the mixer rejects all products except the 455 kHz product. The wideband bandpass filter provides a ±15 kHz second IF bandwidth.

4-4.2.2.2 21.855 MHz Local Oscillator. This crystal controlled oscillator provides the local oscillator injection signal for the second mixer.

4-4.2.2.3 455 kHz IF Amplifier. This amplifier consists of a five-stage limiter and provides most of the overall 100 dB gain of the IF section. The limiting function improves the sensitivity and interference rejection capability of the receiver.

4-4.2.2.4 FM Detector. The limiter amplifier drives an FM quadrature detector which converts the modulation information on the frequency modulated IF signal to a wideband audio signal. The bandwidth of the audio output signal is 12 kHz. This

wideband output is used for processing 16 kb/s secure voice data in the SVM when it is attached to the radio set. Otherwise in normal operation, a jumper plug is inserted into the SVM connector which routes the wideband audio signal directly to the narrowband audio circuits in the SYNTH/AF module.

4-4.2.2.5 Squelch Function. The squelch function mutes or quiets the audio output of the receiver when a signal is not being received. This circuit samples the noise above the standard speech band (3 kHz) in the 8 kHz range and converts it to a DC control signal. When no carrier is present the noise level is high and the DC control signal will be high. When a carrier is present the noise level is reduced which reduces the DC control level. The DC signal drives a threshold comparator which provides a two state output; on or off. This output is routed to the SYNTH/AF module where it is used to control the operation of the microcontroller and the squelch gate for the receiver audio output. The RF input level at which the squelch is disabled (or turned off) is presettable by an internal adjustment in the RF/IF module. The squelch may also be momentarily disabled by pressing the SQ DSBL button on the radio set panel.

4-4.2.3 Narrowband AF Section. These functions are contained in the SYNTH/AF module and include the speech filter, speaker/handset amplifier, squelch-gate, and speaker mute circuits.

4-4.2.3.1 Speech Filter. In normal non-secure speech operation, the information bandwidth is 300 Hz to 3 kHz. The speech filter passes this frequency band and attenuates frequencies above and below it. Of special importance is the attenuation of the wideband audio noise above 3 kHz which improves the receiver output signal-to-noise ratio (S/N) by 6 dB. The output from the speech filter is routed to the audio power amplifier.

4-4.2.3.2 Speaker/Handset Amplifier. This audio power amplifier provides over 26 dB of gain which increases the audio output level to 100 milliwatts for the internal speaker (47 ohms) and 7 milliwatts for the handset (600 ohms).

4-4.2.3.3 Squelch Control. This circuit controls (or gates) the receiver audio output by switching DC power off to the audio amplifier when no RF signal is present or switching DC power on when an RF signal is present. This feature not only quiets the receiver output but also reduces power consumption. The squelch gate is controlled by the microcontroller. The microcontroller receives its control signal from the squelch circuits in the RF/IF module (squelch mute) or from the SQ DSBL pushbutton (squelch disable).

4-4.2.3.4 Speaker Mute. This circuit automatically quiets the internal speaker when a handset is connected to the audio connector on the radio set. When the handset is removed the internal speaker is automatically enabled. The DC resistance of the handset earpiece, when connected, changes the DC bias voltage on a series FET switch which turns the FET off and opens the audio line to the internal speaker.

4-4.3 Transmit Operation. The transmitter is packaged in both modules. The RF/IF module contains the RF and transmit mixer functions. The SYNTH/AF module contains the AF and transmit IF functions.

4-4.3.1 AF Section. Included in this section are the microphone speech amplifier/limiter, 150 Hz amplifier and filter, and the speech filter.

4-4.3.1.1 Speech Amplifier/Limiter. This circuit linearly amplifies the low level microphone signal to a nominal level of 6V p-p while providing a symmetrically limited output of 8V p-p for higher than normal speech level. The limiter function prevents overmodulation by restricting the maximum carrier frequency deviation to a specified level. The amplifier provides a gain of 70 dB.

4-4.3.1.2 150 Hz Amplifier. This circuit amplifies the 150 Hz square wave tone generated by the microcontroller to a level of 5V p-p. An RC low-pass filter prior to the amplifier shapes the 150 Hz tone to a sawtooth waveform. The 150 Hz tone is generated only in the transmit mode and is used to trigger the tone-squelch circuit in the PRC-77 and VRC-12 radios. The 150 Hz tone is disabled (J1-9) when an SVM is attached to the radio set.

4-4.3.1.3 Speech Filter. The purpose of this circuit is to attenuate the harmonic frequencies generated by the limiter-amplifier in order to minimize the modulation bandwidth of the transmitted signal. The circuit is a unity gain, active low-pass filter with a cutoff (-3 dB) frequency of 3 kHz. The filter also attenuates any high frequency background noise which may be picked up by the microphone. When an SVM is attached to the radio set, the output signal from the Speech Filter (J2-22) is routed to the SVM for speech ciphering. In normal use, without an SVM, the signal is routed through the jumper plug (J1-14 to 1) and back to the 21.4 MHz deviation oscillator in the SYNTH/AF module (J2-18). This normal mode of operation is plain text, nonsecure speech. The SVM mode is cipher text, secure speech.

4-4.3.2 IF Section. This section includes the 8.5 Vdc voltage regulator, 21.4 MHz deviation oscillator, and 21.4 MHz low-pass filter.

4-4.3.2.1 8.5 Vdc Regulator. This regulator provides a stable supply voltage for the deviation oscillator and bias voltage for the varactor-tuned modulation circuits.

4-4.3.2.2 21.4 MHz Deviation Oscillator. The purpose of this circuit is to frequency modulate a 21.4 MHz IF transmit carrier signal with either a cipher signal from the SVM or a plain signal directly from the speech amplifier. This frequency modulation is accomplished by superimposing the cipher or plain signal on a DC bias voltage and applying the combined signal to a varactor diode (voltage variable capacitor). The changing amplitude of the audio signal varies the capacitance of the varactor diode which, in conjunction with other components in the modulation circuit, changes or deviates the oscillator carrier frequency symmetrically on either side of the 21.4 MHz center frequency. The frequency deviation is directly proportional to the positive and negative audio amplitude variations superimposed on the varactor DC bias voltage. An internal potentiometer allows adjustment of the bias voltage which in turn varies the 21.4 MHz carrier center frequency. The normal frequency deviation for plain speech is $\pm$8 kHz with a sine wave audio input amplitude of 5V p-p ($\pm$2.5V p-p on DC bias). The frequency deviation for secure speech is approximately $\pm$5.5 kHz with a ciphered digital input signal. When the input signal to the microphone is louder than normal the limiter-amplifier clips the signal to a constant amplitude to prevent over-modulation of the carrier. An internal variable capacitor adjustment allows the maximum frequency deviation to be set to a level less than $\pm$12 kHz proportional to the amplitude of the limited

speech signal. The nominal setting for this adjustment is ±10 kHz deviation. The nominal frequency deviation for the 150 Hz squelch tone is ±2.5 kHz with a 2V p-p input signal.

4-4.3.2.3 21.4 MHz Low-pass Filter. This filter passes the 21.4 MHz transmit IF carrier signal and attenuates all harmonics by greater than 40 dB in order to minimize unwanted spurious products in the transmit mixer circuit. The 21.4 MHz transmit IF output signal is routed through J2-2 to the transmit mixer in the RF/IF module.

4-4.3.3 RF Section. This section consists of the transmit mixer, varactor-tuned preamplifiers, diode switches, power amplifiers, power control, harmonic filters, and antenna matching circuits.

4-4.3.3.1 Transmit Mixer. This circuit is a passive, double-balanced, diode mixer. The desired output signal from the mixer is the difference product of the 21.4 MHz transmit IF input and the 51.4 to 109.4 MHz synthesizer VCO input. The difference product comprises the frequencies from 30 to 88 MHz. The low band VCO generates the local oscillator frequencies from 51.4 to 72.4 MHz and the resultant low band operating frequencies from 30 to 51 MHz. The high band VCO generates the local oscillator frequencies from 72.4 to 109.4 MHz and the resultant high band operating frequencies from 51 to 88 MHz. The varactor-tuned preamplifiers following the mixer select and amplify the difference product depending on low band or high band operation, respectively.

4-4.3.3.2 Varactor-tuned RF Preamplifiers. These low level RF amplifiers are also used in the receive mode (para. 4-4.2.1.4). Diode switches transfer the receive-transmit signals for the respective modes of operation. In the transmit mode, the amplifiers are used to amplify one of the two band products from the transmit mixer. If the operating frequency is in the 30 to 51 MHz range, the low band amplifier is automatically turned on and the high band amplifier is turned off. The opposite switching occurs if the operating frequency is in the 51 to 88 MHz range. Each amplifier has a nominal power gain of 15 dB and provides 50 dB relative attenuation to the transmit mixer image product (other band). The amplifiers are voltage tuned with the synthesizer PLL control voltage tune volts (J2-9). Frequency versus voltage tracking is accomplished with a set of six matched varactor diodes (two for the VCO and two for each rf amp) and series capacitive padders. These tuned circuits warp the tuning curves of the two rf amps such that their tracking error is maintained to within 3 dB maximum. The nominal preamplifier output signal level is 70 mV at the power amplifier input.

4-4.3.3.3 Power Amplifiers. This section consists of three stages of power gain. The amplifiers are broadband covering the complete 30 to 88 MHz frequency range in one band with no manual tuning required. The overall power gain is 46 dB with a minimum output power level of one watt. The driver amplifiers have a nominal gain of 28 dB. The final power amplifier has a nominal gain of 15 dB. The power control circuit and the current control potentiometer provide for setting the output to the one watt level at the maximum rated current. The output signal is routed through a diode switch to the harmonic filters.

4-4.3.3.4 Diode Switches. The diode switches transfer the transmitter output signal to the harmonic filters while isolating the receiver input from the transmitter and filters. These switches are controlled by the transmit and chopped B+ lines as determined by the PTT switch position.

4-4.3.3.5 Harmonic Filters. These filters pass the desired transmit carrier frequency while rejecting the harmonics of the carrier. Two filter bands (LO,HI) are necessary to provide the required amount of attenuation to the harmonics. The bands are 30 to 51 MHz and 51 MHz to 88 MHz. Band selection is accomplished by the HI band and LO band control signals from the microcontroller.

4-4.3.3.6 Antenna Matching Networks. This section is divided into five frequency bands and a direct 50 ohm output. Band selection is accomplished manually by setting the ANT match switch to the correct position (A-B-C-D-E-50). These circuits impedance match the antenna to the transmitter to provide maximum radiated power from the antenna. The 50 ohm rf input/output position bypasses the antenna matching networks and provides a direct 50 ohm interface with a power amplifier, test equipment or other antenna systems. A DC path to ground of 2000 ohms or less must be provided between the antenna terminal and ground when transmitting or receiving in the 50 ohm output position. If the antenna does not provide this DC path, an external path must be provided with an RF impedance greater than 1000 ohms.

4-4.4 Frequency Synthesizer Operation. The frequency synthesizer circuits consist of two sections. The phase-lock-loop (PLL) is contained in the SYNTH/AF module except for the voltage-controlled-oscillator (VCO), which is contained in the RF/IF module. The control section is contained in the SYNTH/AF module.

4-4.4.1 PLL Section. The PLL section includes the voltage-controlled-oscillators, buffer amplifier/regulator, ÷40/41 prescaler, frequency synthesizer, reference oscillator, and loop filter. The PLL generates a stable 51.4 to 109.4 MHz injection frequency for the transmit and receive mixers. This stability is accomplished by phase-locking a variable frequency VCO (51.4 to 109.4 MHz) to a fixed frequency reference oscillator (6.4 MHz). Both oscillators are frequency divided to a phase detector frequency of 25 kHz for phase comparison. A DC voltage proportional to phase difference is then generated, filtered, and applied to a voltage variable capacitance (varactor) diode in the VCO circuit. When phase-locked to the reference oscillator, the VCO frequency stability is $\pm$12.5 parts per million (ppm) over the -40°C to +55°C temperature range. The receive mode frequency stability is the same as the VCO stability. However, in the transmit mode, the stability of the deviation oscillator is added to the VCO stability. The resultant transmit frequency stability is specified at $\pm$25 ppm at 88 MHz.

4-4.4.1.1 Voltage Controlled Oscillators. Dual oscillators are tuned with a 1.8 to 9.5 Vdc control voltage (tune volts) generated by the PLL synthesizer loop filter. The LO band or HI band control lines determine which oscillator is turned on or off. The LO band oscillator covers the range from 51.4 MHz to 72.4 MHz. The HI band oscillator covers the range from 72.4 MHz to 109.4 MHz. A varactor diode is used in conjunction with other tuned circuit components to provide the required frequency control.

4-4.4.1.2 Buffer Amplifier/Regulator. This circuit provides a dual function. The buffer amplifier isolates the VCO from load reflections to minimize VCO noise and spurious signals within the PLL. The regulator provides a stable DC supply voltage for the VCO and the ÷40/41 prescaler. The nominal output signal level from the buffer amplifier to the transmit and receive mixers is 300 mV. The nominal VCO output signal to the prescaler is 300 mV and is superimposed on the regulated +7.5 Vdc supply voltage to the ÷40/41 prescaler in the SYNTH/ AF module (J2-13).

4-4.4.1.3 ÷40/41 Prescaler. This circuit is a frequency divider which divides by 40 or 41 as determined by a control signal generated within the frequency synthesizer. The prescaler, in combination with the divide-by-N counters within the synthesizer, divide the VCO frequency down to 25 kHz for phase comparison.

4-4.4.1.4 Frequency Synthesizer. This circuit consists of additional frequency dividers, a reference oscillator and the phase-frequency detector. The frequency divider ratio (divide-by-N) for the PLL synthesizer is supplied by a serial input data word stored in the 64 x 16 bit electrically erasable programmable read only memory (EEPROM). This data word is a number that, when divided by the incoming, prescaled, VCO frequency, results in a frequency of 25 kHz that is applied to the phase-frequency detector. The EEPROM data is determined during the frequency programming sequence from the microcontroller. This same data is also provided back to the microcontroller for bandswitch control. If the selected frequency is between 30.000 and 50.975 MHz the low band will be activated. If the selected frequency is between 51.000 and 87.975 MHz the high band will be activated.

4-4.4.1.5 Phase-Frequency Detector. A fixed frequency divider (÷256) divides the 6.4 MHz reference oscillator down to 25 kHz for phase comparison in the phase-frequency detector. The phase-frequency detector provides two functions. The frequency detector first senses the difference in frequency between the fixed reference 25 kHz signal and the divided-down, variable VCO 25 kHz signal. The frequency detector generates a sweep voltage which pulls the VCO closer to the reference. As the VCO frequency approaches the reference frequency, the phase detector then takes control and generates a DC control voltage which phase-locks the VCO and reference signals. In this phase-locked condition, the stability and accuracy of the VCO frequency is equivalent to the reference oscillator.

4-4.4.1.6 Reference Oscillator. The active circuitry for this oscillator is contained within the frequency synthesizer integrated circuit. The quartz-crystal controlled, reference oscillator generates the PLL frequency standard to which the VCO is phase-locked for frequency stability and accuracy. The room temperature accuracy of the reference oscillator is adjustable. The temperature stability of the oscillator, measured with respect to room temperature accuracy, is ±12.5 ppm over the -40°C to +55°C temperature range. The VCO performance is equivalent when phase-locked to the reference oscillator.

4-4.4.1.7 Loop Filter. The PLL filter provides two functions. The first section is a phase-gain compensation network which stabilizes the phase-lock response parameters of the PLL. The last section is an active low-pass filter which attenuates the phase detector fundamental (25 kHz) and harmonic frequencies. The attenuation provided by this filter reduces the incidental frequency modulation (IFM) on the VCO frequency to less than 100 Hz deviation. The loop filter also provides DC amplification of the phase detector control signal to the 1.8 to 9.5 Vdc range required by the VCO for frequency coverage from 51.4 to 109.4 MHz. The output of the loop filter is the tune volts line (J2-9).

4-4.4.2 Control Section. The control section includes the microcontroller, EEPROM and the external operator controls. This section provides digital data conversion and processing of operator selected channel and mode information. This digital

processing is done in parallel format between the microcontroller and external controls and in serial format between the microcontroller and LCD display, frequency synthesizer or EEPROM.

4-4.4.2.1 Microcontroller. The microcontroller is the central processing unit (CPU) that converts frequency selection information to serial digital data. It also distributes serial data and clock to the memory for storage or receives data from the memory for band control. The memory also supplies data to the frequency synthesizer whenever a channel selection is made. The instruction program for the microcontroller is permanently masked into an internal read-only-memory (ROM). A 76.8 kHz crystal-controlled oscillator provides the clock standard for waveform timing and data conversion, processing, and transfer. The microcontroller accepts and generates the following waveforms and control signals:

a. 150 Hz squelch tone output
b. Battery saver chopped B+ output
c. Low-battery/antenna mismatch warning tone outputs
d. Clock output
e. Serial data input/output
f. External program data input/output and repeater transmit PTT output
g. Enable outputs (EEPROM, synthesizer)
h. Low battery detect input
i. HI band output
j. LO band output
k. Receive B+ output
l. Transmit B+ output
m. Squelch mute input
n. PTT input
o. Squelch gate output
p. External load sense input (J7)
q. Squelch disable input
r. Strobe inputs
s. CHAN switch strobe outputs
t. SET/INC switch strobe output
u. ANT switch strobe output
v. Liquid crystal display clock output
w. Liquid crystal display data output
x. Liquid crystal display lighting control output

4-4.4.2.2 Preset Memory. This device is an electrically erasable programmable read only memory (EEPROM) with the capacity to store frequency selection data for twenty channels. All twenty channels (10 receive and 10 transmit) can be randomly programmed to unrelated frequencies and stored for an indefinite period of time. Frequency data recall and frequency changing of the radio set is accomplished immediately when a channel selection is made. The memory is nonvolatile and does not require power to retain data. An enable signal from the microcontroller determines the read/write status of the EEPROM. Programming is accomplished using the procedures given in paragraph 3-4.

4-4.4.2.3 External Operator Controls. The SQ DSBL, SET, INC, ANT and CHAN switches all interface directly with the microcontroller. The microcontroller senses a high or low on the SQ DSBL, SET and INC input lines. If the SQ DSBL

input is low, the microcontroller outputs a high on the squelch gate line to enable the audio amplifier. The PTT switch provides a ground when depressed which tells the microcontroller to go into the transmit mode of operation. The SET and INC switches apply a low to the microcontroller during the programming sequence to select the desired frequency. The ANT and CHAN switches are connected to the microcontroller in a switch matrix configuration. The microcontroller generates strobe pulses on the switch output lines and simultaneously reads the strobe input lines to determine the switch settings.

4-4.5 Special Functions. The special functions generated by the microcontroller circuit are the 150 Hz tone, battery saver timing waveform, battery warning tone and antenna warning tone.

4-4.5.1 150 Hz Tone. This signal is a periodic square wave with an amplitude of 5V peak and a frequency of 150 Hz $\pm$1 Hz. The tone is derived from the 76.8 kHz clock standard and therefore has the same accuracy. The 150 Hz tone is filtered and used to modulate the transmit carrier signal for compatibility with the tone-squelch in the PRC-77 and VRC-12 receivers. This tone is generated during transmit but only in the nonsecure mode.

4-4.5.2 Battery Saver Timing Waveform. These signals are a periodic square wave with amplitudes of 5V peak. The on-time (+5 Vdc) is 54 milliseconds and the off-time is 161 milliseconds when in the secure mode. The timing accuracy is derived from the 76.8 kHz clock standard. This signal is amplified to 15V peak and used as the CHOPPED B+ and HI or LOW Band voltages for duty-cycle portions of the receiver during the squelched-standby mode of operation. The CHOPPED B+ line is also routed to the SVM (J1-3) to accomplish the same purpose in that module. When in the non-secure mode periodic waveforms of approximately 220 µs are utilized. Various on-times (+5 vdc) are utilized for the chopped B+, REC B+ and HI-LO control lines. The battery saver signals are generated only in the squelched-standby mode of operation.

4-4.5.3 Battery Warning Tone. This signal consists of a series of four 400 Hz "beeps" every six seconds. In conjunction with a voltage comparator circuit, this tone is used to provide the operator with an aural warning that the battery is nearing end-of-life (EOL). The warning circuit monitors the battery voltage and compares it to a preset, fixed reference voltage. When the battery voltage drops below the preset reference, the comparator switches states and applies a low to the microcontroller. The microcontroller then turns on the speaker/headphone amplifier (squelch gate output) and disables the receiver noise (noise mute output). This allows the tone to be heard by the operator. The tone amplitude is adjustable with the panel VOL (volume) control. The low-battery tone is generated only during the squelched-standby mode and is automatically disabled when a signal is being received or when the radio is used to transmit.

4-4.5.4 Antenna Warning Tone. This signal is generated within the microcontroller and consists of a 400 Hz tone occurring at 2 tones per second rate. The microcontroller monitors the ANT switch position and generates the tone whenever its

position does not agree with the selected frequency. In addition, the microcontroller senses when a 50 ohm load (LOAD SENSE J3-16) is connected at the ANT connector and then generates the warning tone until the ANT match switch is set to the "50" position (50 ohm output). A DC path to ground of 2000 ohms or less must be provided between the antenna terminal and ground when transmitting or receiving in the 50 ohm output position. If the antenna does not provide this DC path, an external path must be provided with an RF impedance greater than 1000 ohms. The microcontroller controls the audio circuitry in the same manner as during low battery tone operation. Transmit operation of the radio set is disabled whenever a mismatch is detected.

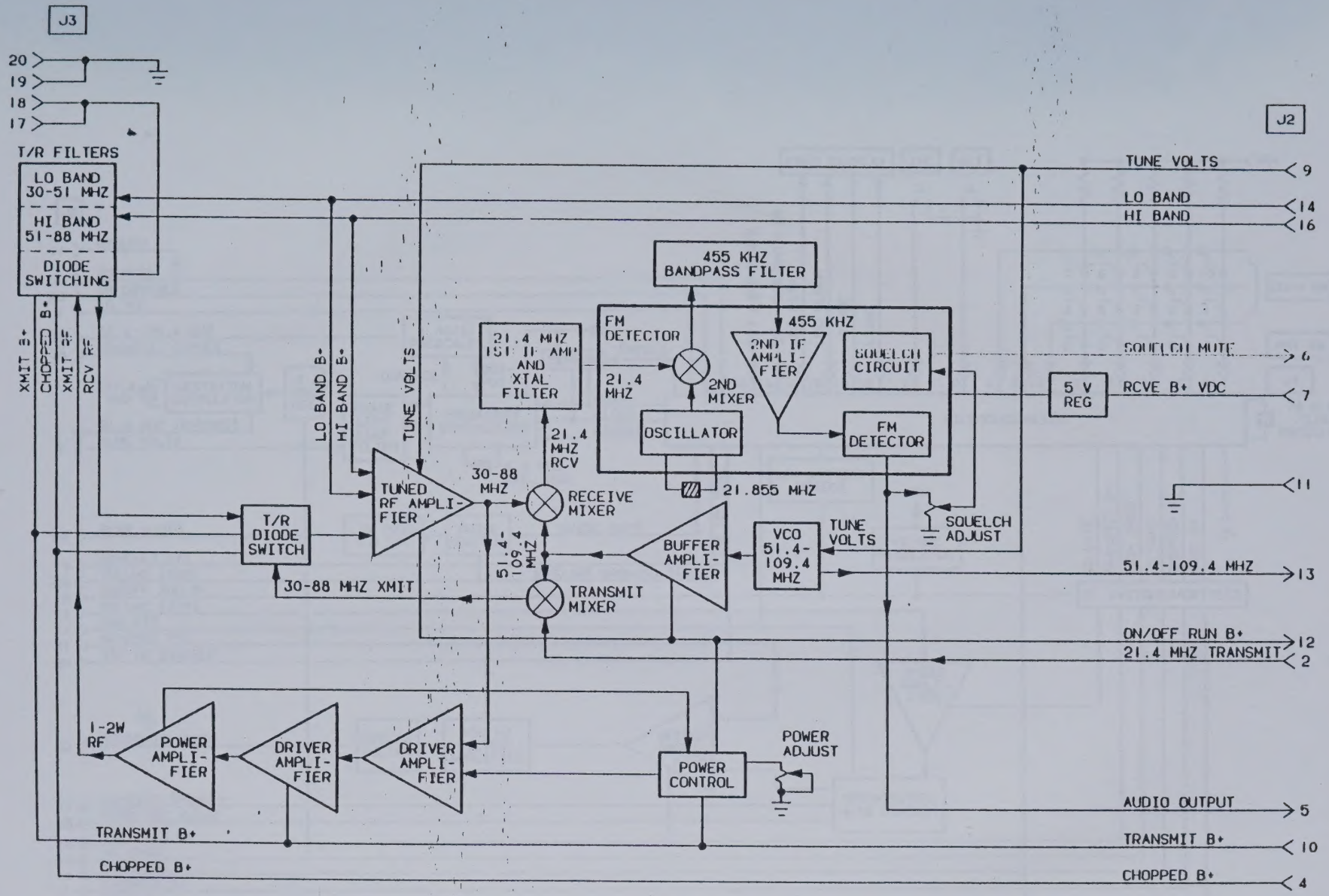


Figure 4-3. RF/IF Module Block Diagram

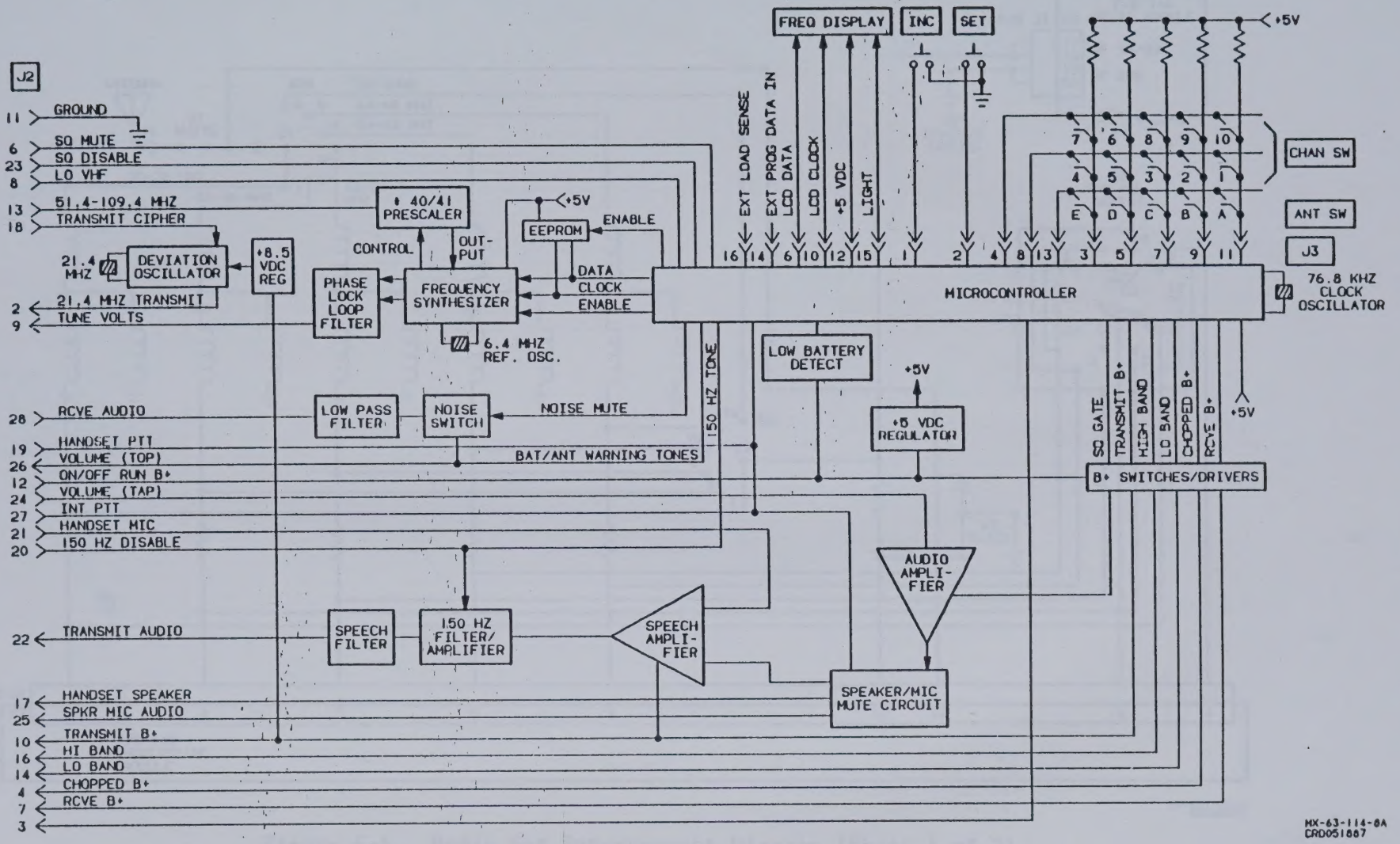


Figure 4-4. Synth/AF Module Block Diagram

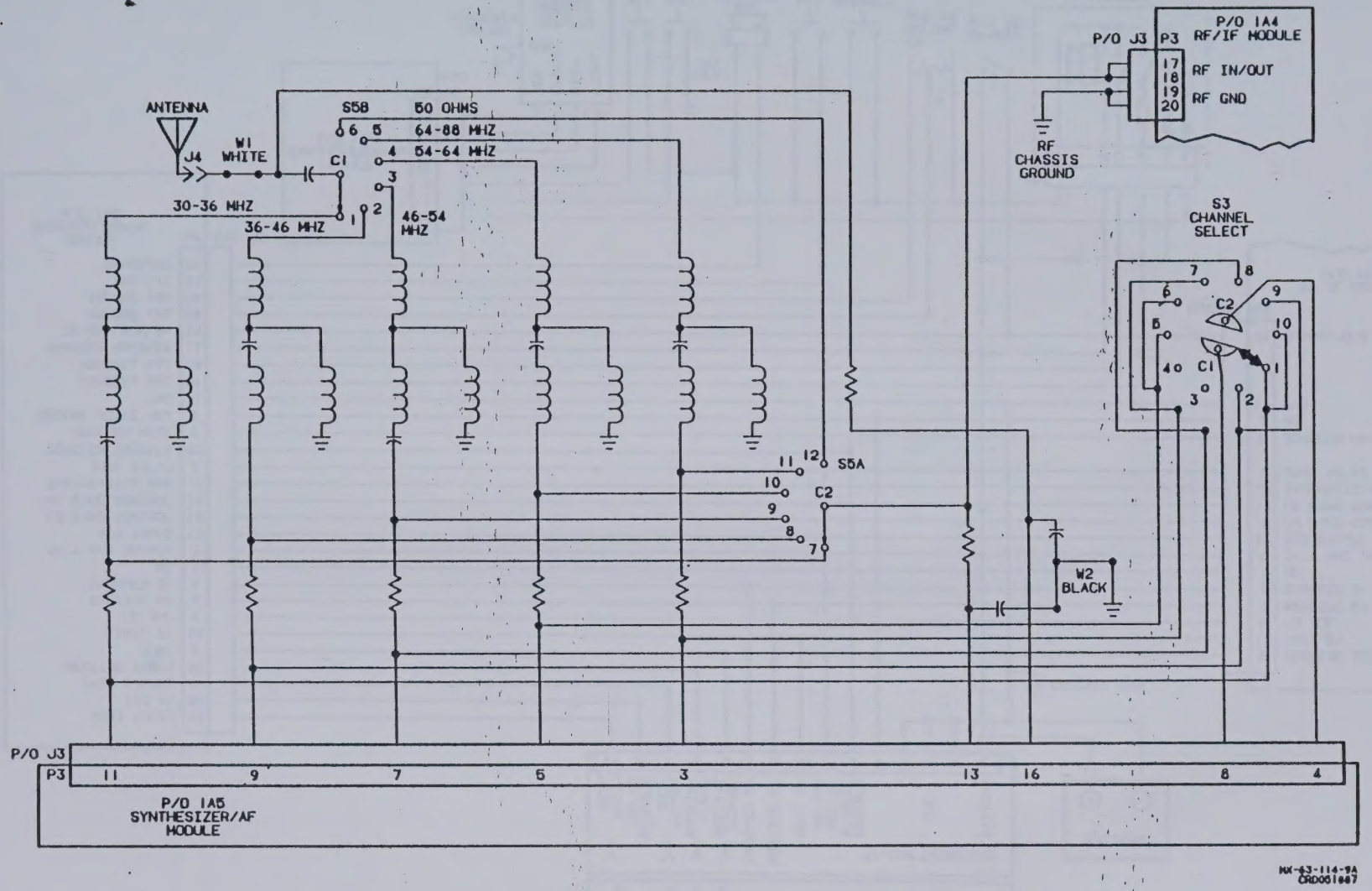
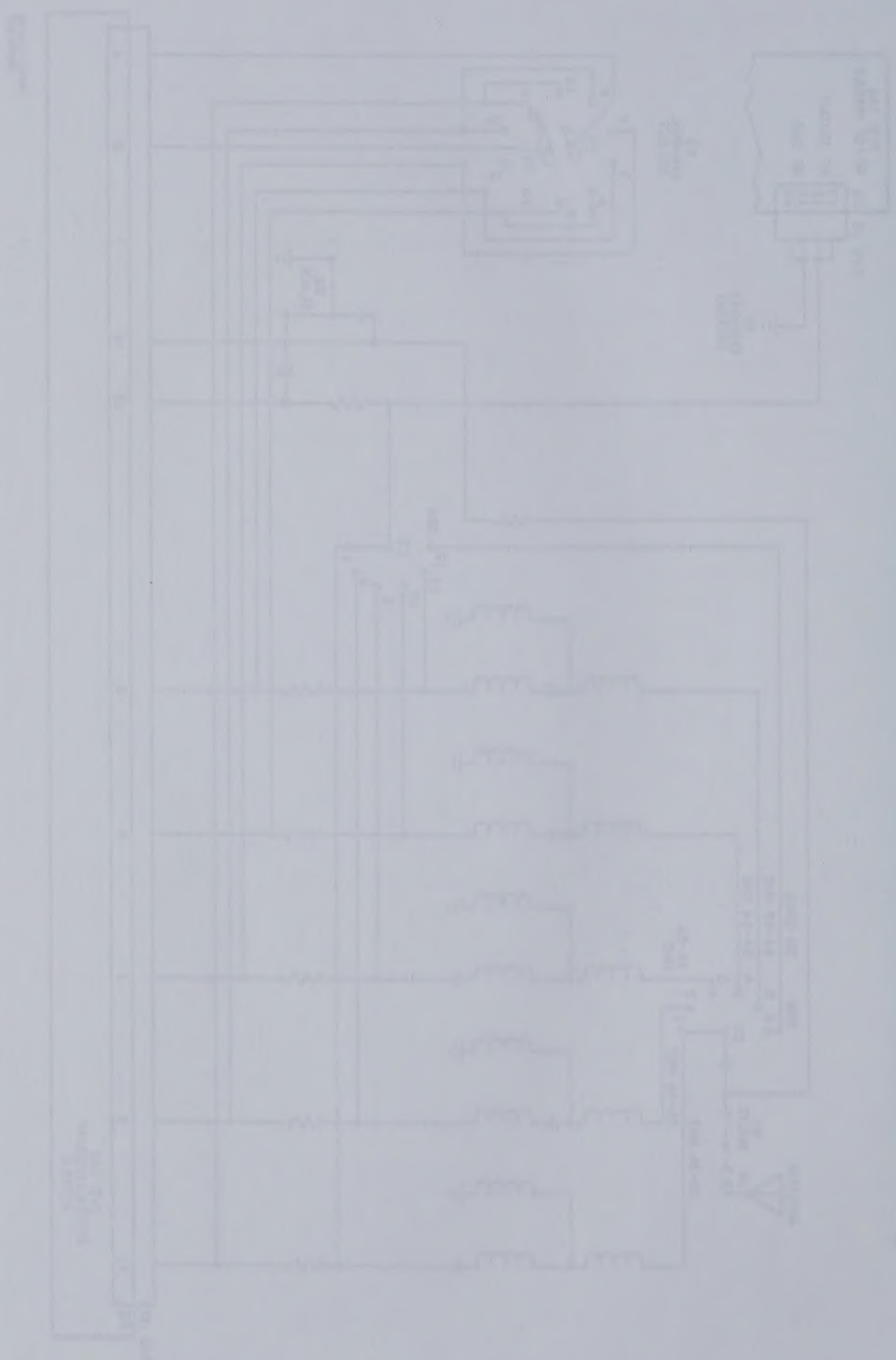


Figure 4-5. Radio Set Interconnect Diagram (Sheet 1 of 2)



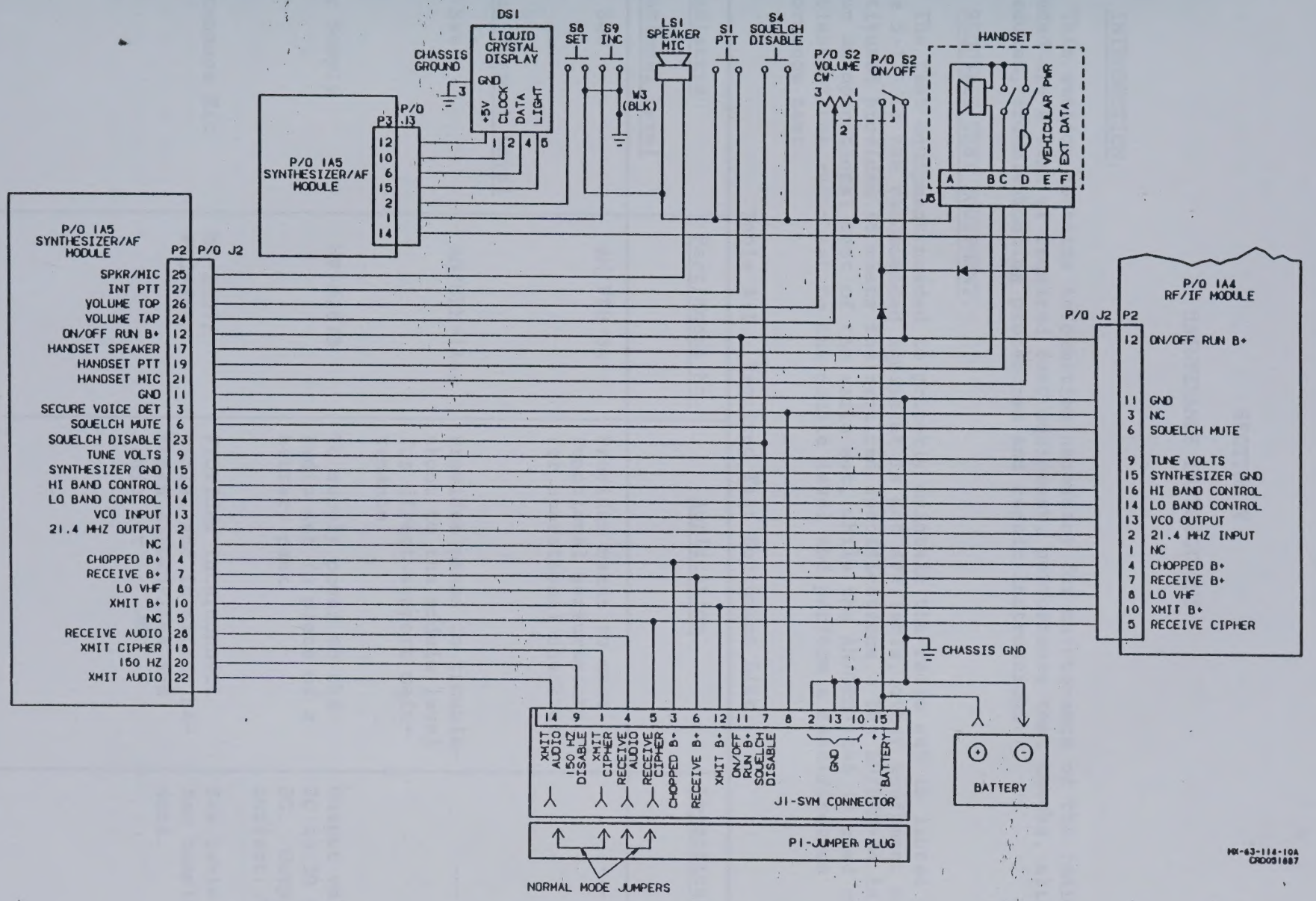


Figure 4-5. Radio Set Interconnect Diagram (Sheet 2 of 2)

SECTION V

MAINTENANCE INSTRUCTIONS

5-1 INTRODUCTION.

This section contains information necessary for maintenance of the radio set. Included are a list of required test equipment, performance test checks, alignment procedures, troubleshooting procedures and repair instructions.

5-2 REQUIRED TEST EQUIPMENT.

The test equipment needed to properly maintain the radio set is listed in table 5-1. If the recommended equipment is not available, other equipment may be substituted provided it meets the required specifications. The AN/PRM-34 is used to run an operational test of the radio set, while the AN/GRM-114A is used to troubleshoot the radio set to the module level and perform a specification performance test.

Table 5-1. Required Test Equipment List

Nomenclature	Part/Model No.	Application	Specifications
Operational Level			
Test Set	AN/PRM-34	Provides means to make functional measurements for operational checkout	---
Direct Support Level			
Test Set	AN/GRM-114A	Provides means to troubleshoot to the module level for direct support maintenance.	---
Power Supply	HP-6267B	To supply power to the radio set in place of a battery pack.	Output voltage 20 to 30 volts DC. Output current: 0.5A
Maintenance Kit	MK-2137/PRC-68	Provides interconnect cables and interface between AN/GRM-114A and radio set	See table 5-5 for complement data.

5-3 CLEANING, PAINTING AND LUBRICATION.

5-3.1 Cleaning. The exterior surfaces of the radio set should be clean, free from dust, dirt, grease, and fungus. Clean the exterior as follows:

a. Remove dust/loose dirt with a clean, soft cloth (item 2, table 1-2).

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Avoid prolonged breathing of vapor. Do not use solvent near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, avoid prolonged contact with skin. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

b. Remove grease, fungus, and ground-in dirt from the radio set with a cloth dampened (not wet) with trichlorotrifluoroethane (item 6, table 1-2).

c. Remove dust or dirt from antenna and audio connectors with a brush.

5-3.2 Painting. Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper (item 4, table 1-2). Use a brush (item 1, table 1-2) to apply two thin coats of paint (item 3, table 1-2) on the bare metal to protect from further corrosion.

CAUTION

Do not paint the ANT or AUDIO connectors.

5-3.3 Lubrication. Prior to reassembly of the radio set, all sealing surfaces (module cover and battery case) should have a thin film of silicone grease (item 5, table 1-2) applied to help preserve watertightness and keep the rubber seals pliable. A small amount of silicone grease should also be applied to the "O" ring in the handset connector to facilitate insertion.

5-4 PERFORMANCE VERIFICATION.

5-4.1 Test Equipment Setups. The test setup requirements for performing the operational checkout procedure is shown in figure 5-1. The test setup requirement for performing the direct support maintenance procedures is shown in figure 5-2.

5-4.2 Operational Checkout and Maintenance Procedures. Table 5-2 contains the operational checkout procedure for the radio set. This procedure is performed to ensure the radio set meets acceptable operational performance standards. Table 5-3 covers the direct support test procedures and isolation steps needed to determine the nature of a fault prior to troubleshooting. If a fault exists, the "fault isolation" column of the procedure will indicate the most likely faulty assembly, reference an adjustment procedure, or reference optional troubleshooting checks.

With only 3 replaceable assemblies (RF/IF module, synth/RF module and frame/panel assembly) the most effective method of repair may be to change modules as indicated in table 5-2. If spare modules are not readily available it may be necessary to perform more detailed fault isolation as referenced in table 5-2 and performed in table 5-4.

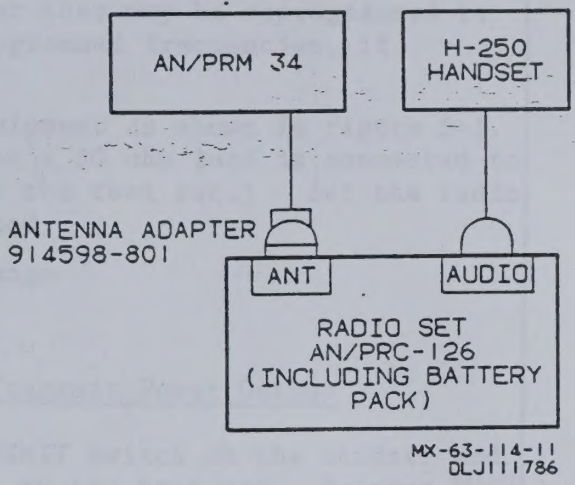


Figure 5-1. Operational test setup

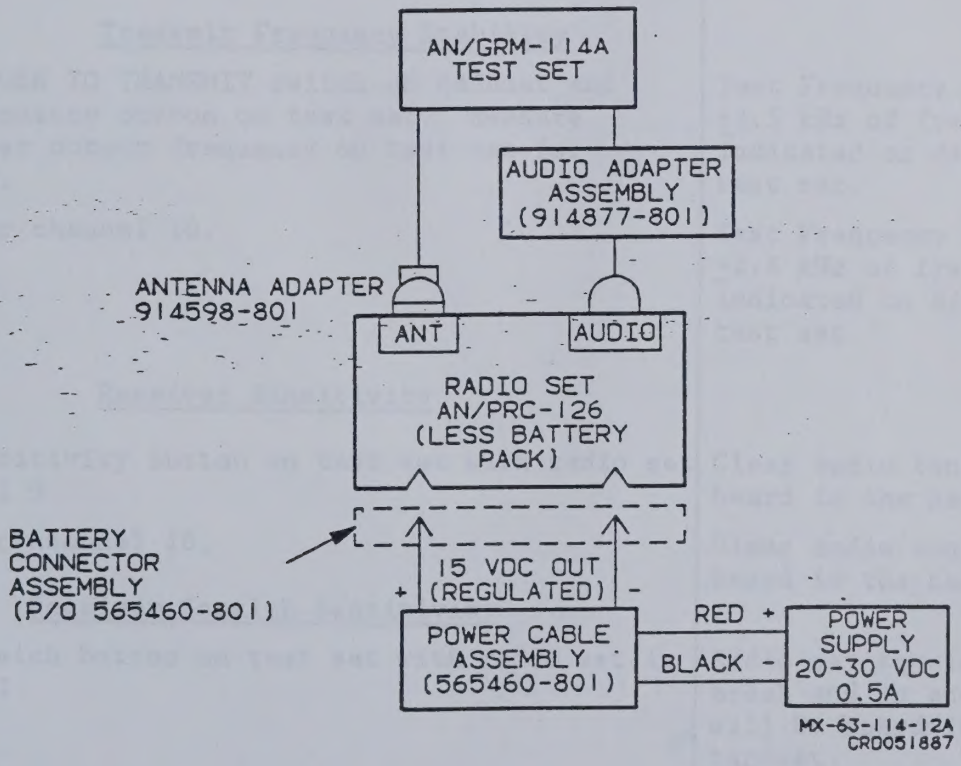


Figure 5-2. Direct support test setup

Table 5-2. Radio Set Operational Checkout Procedure

Step	Procedure	Required Indication
1.	Before running the operational test use the instructions of para. 3-4.2 & 3-4.3 to preset channel 9 to 45.000 MHz and channel 10 to 75.000 MHz. (After the test they may be reprogrammed to their originally programmed frequencies, if required.)	
2.	Connect the test equipment as shown in figure 5-1. (Be sure the test set's 50 ohm load is connected to the ant connector of the test set.) Set the radio set controls as listed: OFF/VOL - midrange CHAN - 9 ANT - 50	
	Transmit Power Output	
3.	Depress PUSH TO TRANSMIT switch on the handset and measure power output on the test set. Release PUSH TO TRANSMIT.	1 watt nominal
4.	Repeat for channel 10.	1 watt nominal
	Transmit Frequency Stability	
5.	Depress PUSH TO TRANSMIT switch on handset and press frequency button on test set. Measure transmitter output frequency on test set for channel 9.	Test Frequency within ±2.5 kHz of frequency indicated on display of test set.
6.	Repeat for channel 10.	Test Frequency within ±2.5 kHz of frequency indicated on display of test set.
	Receiver Sensitivity	
7.	Press sensitivity button on test set with radio set in Channel 9.	Clear audio tone will be heard in the handset.
8.	Repeat for channel 10.	Clear audio tone will be heard in the handset.
	Receiver Squelch Sensitivity	
9.	Press squelch button on test set with radio set in channel 10.	Radio set squelch will break and an audio tone will be heard in the handset.

Table 5-3. Radio Set Direct Support Maintenance (DSM) Procedure

Step	Procedure	Required indication	Fault isolation step
1.	Remove radio set antenna, handset, battery case, and battery. Set the radio set controls as listed. OFF/VOL - OFF CHAN - 1 ANT - 50		
2.	Connect power cable assembly to radio set battery connectors (see figure 5-2) and adjust power supply output for 20 to 30 Vdc.		
	LOCAL CONTROLS/INDICATORS		
3.	Turn (ON-OFF Vol Control) clockwise to turn radio set on.	After several seconds, display indicates last operating frequency.	Replace Synth/AF assy or per table 5-4, check J2-11, 12.
4.	Refer to paragraphs 3-4.2 and 3-4.3 and reprogram the radio set for any frequency between 30.000 and 87.975 MHz. (Reprogram back to original frequency if desired.)	Programming is accomplished using the CHAN, SET, and INC switches.	Replace Synth/AF assy or per table 5-4, check J3-1,2,4, 6,8,10,12.
5.	Select channels 1 through 10 on radio set while observing display.	Display indicates the desired frequencies for channels 1-10 as originally programmed.	Replace Synth/AF Assy or per table 5-4, check J2-27, J3-4,-8.
	ANTENNA WARNING TONE		
6.	The antenna warning tone should sound if the antenna switch is in any position other than 50 when the test set RF cable is connected. When the test set RF cable is disconnected the warning tone should cease for the switch positions and frequency ranges shown as follows:	Warning tone (400 Hz at 2 Hz rate) is present or absent according to chart. Tone is clear with no background noise present in speaker.	Replace Synth/AF assy. or per table 5-4, check J3-13,16, J2-24,25,26.

Table 5-3. Radio Set DSM Procedure - continued

Step	Procedure	Required indication	Fault isolation step
6. Cont	Ant Sw Position / Frequency / Range (mHz) A 30.000 thru 35.975 B 36.000 45.975 C 46.000 53.975 D 54.000 63.975 E 64.000 87.975 LOW BATTERY TONE		
7.	Reconnect Test Set RF cable and reset antenna SW to 50. Reduce radio set dc supply voltage to 10.0 Vdc. Check for low-battery warning tone in radio set speaker (adjust VOL as necessary).	Warning tone (three 400 Hz beeps at 6 second intervals) present. Tone is clear with no background noise present in speaker.	Replace Synth/AF assy.
8.	Readjust power supply output for 20 to 30 Vdc. NOTE The following transmit and receive checks can be performed on any of the preset channels. To ensure a complete operational checkout of all possible transmit and receive bands there should be a preset frequency for each of the band segments shown in step 6. As a minimum the radio should be checked out on one frequency below 51 MHz and one above 51 MHz. TRANSMIT MEASUREMENTS NOTE The PUSH TO TRANSMIT button on the radio set (or handset when called for) must be depressed and held for duration of measurement to obtain a reading.		

Table 5-3. Radio Set DSM Procedure - continued

Step	Procedure	Required indication	Fault isolation step
9.	Transmit Power Output Connect the test equipment as shown in figure 5-2. Apply power to test equipment. Set the radio set controls as listed. OFF/VOL - midrange CHAN - any ANT - 50		
10.	Set audio generator output level to minimum (zero).		
11.	Depress PUSH TO TRANSMIT button and measure power output on wattmeter. Release PUSH TO TRANSMIT button.	1 watt nominal	Replace RF/IF assy or per table 5-4, check J2-4,10, 14,16,19, J3-16,17,18,19 20, check power output level adjustment.
	Transmit Frequency Stability		
12.	Depress PUSH TO TRANSMIT button. Measure transmitter output frequency on frequency counter. Release PUSH TO TRANSMIT button.	Test Frequency within ±2.5 kHz of frequency indicated on display.	Replace Synth/AF assy or per table 5-4, check J2-13, 14,16.
	Transmitter Modulation		
13.	Set audio generator frequency to 1 kHz and output level to minimum (zero).		
14.	Depress PUSH TO TRANSMIT button and measure deviation on deviation meter. Release PUSH TO TRANSMIT switch.	2.5 to 3.5 kHz deviation.	Replace Synth/AF assy or per table 5-4, check J2-18.

Table 5-3. Radio Set DSM Procedure - continued

Step	Procedure	Required indication	Fault isolation step
15.	Depress PUSH TO TRANSMIT button and measure squelch tone frequency on counter. Release PUSH TO TRANSMIT button.	150 ±2 Hz	Replace Synth/AF assy.
16.	Depress PUSH TO TRANSMIT button and increase audio generator output level until modulation deviation is 7 kHz on deviation meter. Note audio input level. Release PUSH TO TRANSMIT button.	Less than 1 millivolt rms.	Replace Synth/AF assy or per table 5-4, check J2-21.
17.	Depress PUSH TO TRANSMIT button and measure harmonic distortion of 1 kHz modulation tone. Release PUSH TO TRANSMIT button.	Less than 15% distortion.	Replace Synth/AF assy.
18.	Increase output of audio signal generator until a reading of 10 millivolts on audio voltmeter is obtained. Depress PUSH TO TRANSMIT button and measure limited modulation deviation on deviation meter. Release PUSH TO TRANSMIT button.	Less than 12 kHz deviation.	Replace Synth/AF assy.
	Transmit Microphone		
19.	Disconnect test set audio cable from AUDIO connector on radio set.		
20.	Depress PUSH TO TALK button on radio set. Speak into microphone (hold microphone about 1 inch from mouth) and observe modulation deviation meter. Release PUSH TO TALK switch.	Approximately 7 kHz deviation with peaks limited to less than 12 kHz.	Replace Frame/panel assy.
	RECEIVE MEASUREMENTS		
	CAUTION Do not depress PUSH TO TALK button when radio set is connected for receive measurements.		

Table 5-3. Radio Set DSM Procedure - continued

Step	Procedure	Required indication	Fault isolation step
	Receiver Sensitivity		
21.	Connect test equipment as shown in figure 5-2. Apply power to test equipment. Ensure radio set is on.		
22.	Adjust rf signal generator for a 0.5 microvolt output level at the same frequency as indicated on the radio set display. Set modulation for 1 kHz at 8 kHz deviation. Adjust radio set VOL control for 1.2 vrms audio output level on distortion analyzer VOLTMETER.	Receive audio present on distortion analyzer VOLTMETER.	Replace RF/IF assy per table 5-4, check J2-3,4, 7,10,17,28, check squelch adjustment.
23.	Measure audio output SINAD* ratio on distortion analyzer. *SINAD = $\frac{\text{Signal + Noise + Distortion}}{\text{Noise + Distortion}}$	SINAD* RATIO 10 dB minimum for 0.5 microvolt input.	Replace RF/IF assy.
	Receiver Squelch Sensitivity		
24.	Disconnect test set audio cable from radio set. Reduce rf signal generator output level to minimum (zero). The squelch should activate and quiet audio output of receiver. Slowly increase rf signal generator output level until squelch releases and normal audio output is restored.		
25.	Observe rf signal generator output level.	Less than 0.5 microvolt.	Replace RF/IF assy or check squelch adjustment.
	Receiver Audio Output Distortion		
26.	Reconnect test set audio cable to radio set. Adjust rf signal generator for a 1.0 millivolt output level. Adjust radio set VOL control for 1.2 Vrms audio output level on distortion analyzer VOLTMETER.		

Step	Procedure	Required indication	Fault isolation step
	Receiver Sensitivity		
21.	Connect test equipment as shown in figure 3-2. Adjust power to test equipment. Leave radio set in OFF.		
22.	Adjust rf signal generator for a 0.5 microvolt output level at the same frequency as indicated on the radio set display. Set modulation for 1 kHz at 3 kHz deviation. Adjust radio set VOL control for 1.5 watt audio output level or distortion analyzer VOLTS.	Receive audio present on distortion analyzer VOLTMETER.	Replace A2/U2 assembly. Refer to fig. 3-5, sheet 2, 3, 4, 7, 10, 11, 12, 13, sheet 4 for location.
23.	Observe audio output level on distortion analyzer.	Signal to noise ratio 12 db minimum for 0.5 microvolt input.	Replace A2/U2 assembly.
	Squelch & Noise & Distortion		
	Squelch Sensitivity		
24.	Disconnect test set radio cable from radio set. Adjust rf signal generator output level for 0.5 microvolts. The squelch should activate and quiet audio output distortion. Slowly increase rf signal generator output level until squelch releases and normal audio output is restored.		
25.	Observe rf signal generator output level.	Less than 0.5 microvolts.	Replace A2/U2 assembly or check squelch adjustment.
	Receiver Audio Distortion		
26.	Disconnect test set radio cable to radio set. Adjust rf signal generator for a 1.0 milliwatt output level. Adjust ratio set VOL control for 1.5 watt audio output level as indicated on distortion analyzer VOLTMETER.		

Table 5-3. Radio Set DSM Procedure - continued

Step	Procedure	Required indication	Fault isolation step
27.	Measure receiver audio output harmonic distortion on distortion analyzer.	Less than 15% distortion.	Replace RF/IF assy.
	Receiver Speaker and Speaker Muting		
28.	Disconnect test set audio cable from radio set. The 1 kHz modulation tone should be heard from speaker (adjust VOL as necessary).	1 kHz tone from speaker.	Replace Frame/ Panel assy per table 5-4, check J2-25.
29.	Reconnect test set audio cable radio set. The 1 kHz modulation tone should not be heard (muted) from speaker.	1 kHz tone muted.	Replace Synth/AF assy or per table 5-4, check J2-17.
30.	Testing complete. Turn off power to all equipment.		

5-5 ADJUSTMENT PROCEDURES.

Perform the following adjustment procedure as instructed in the "fault isolation" column of the operational checkout procedure or as required to obtain the desired operation from the radio set. Adjustment location is shown in figure 5-3. An adjustment tool is provided with the radio set and is stored in the bottom of the module cover. To gain access to the adjustment control, disassemble the radio set as follows:

a. Unfasten latches on battery case and remove the battery case and battery (if installed).

b. Remove module cover by turning the two captive screws counterclockwise (located on bottom of module cover).

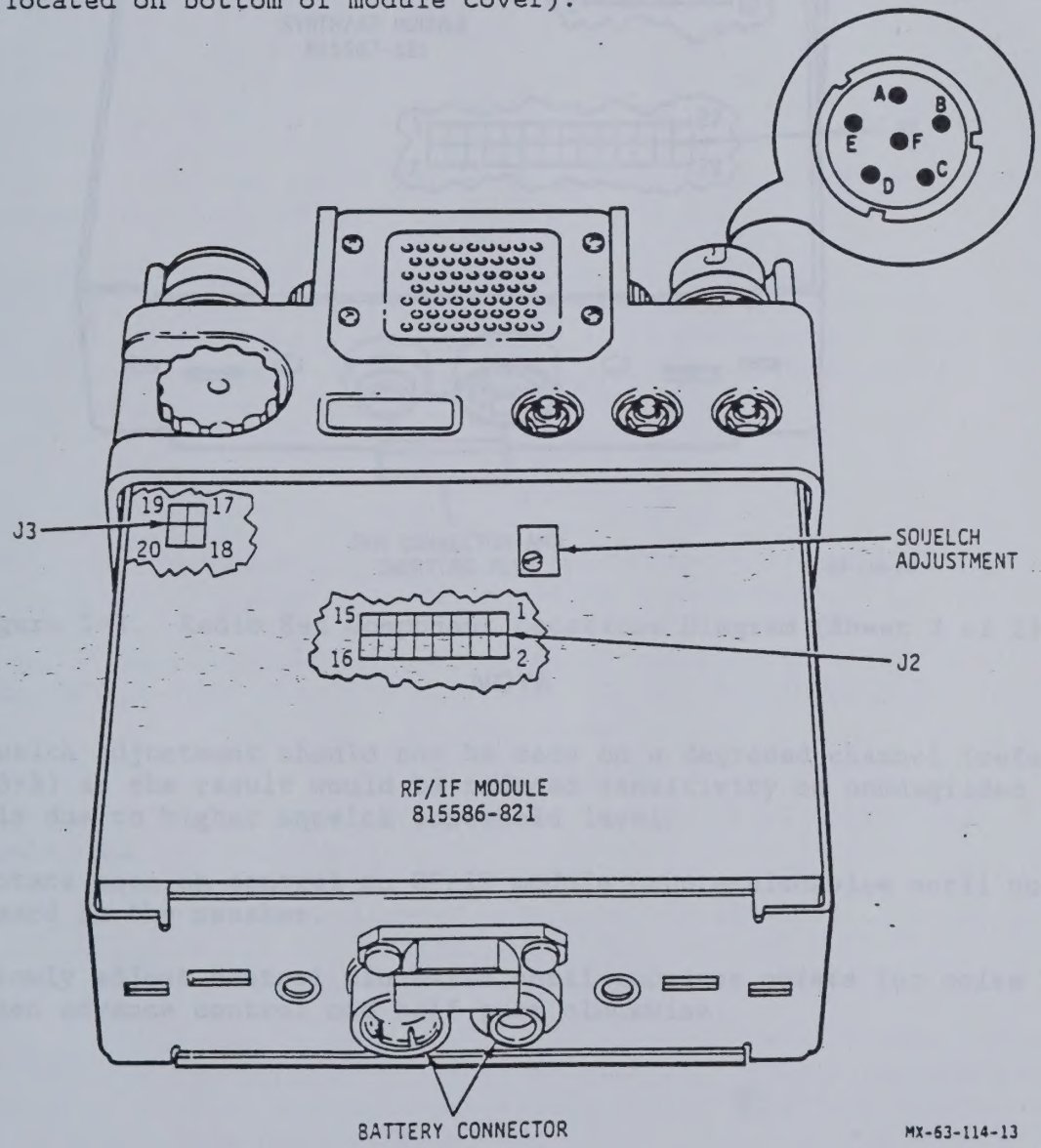
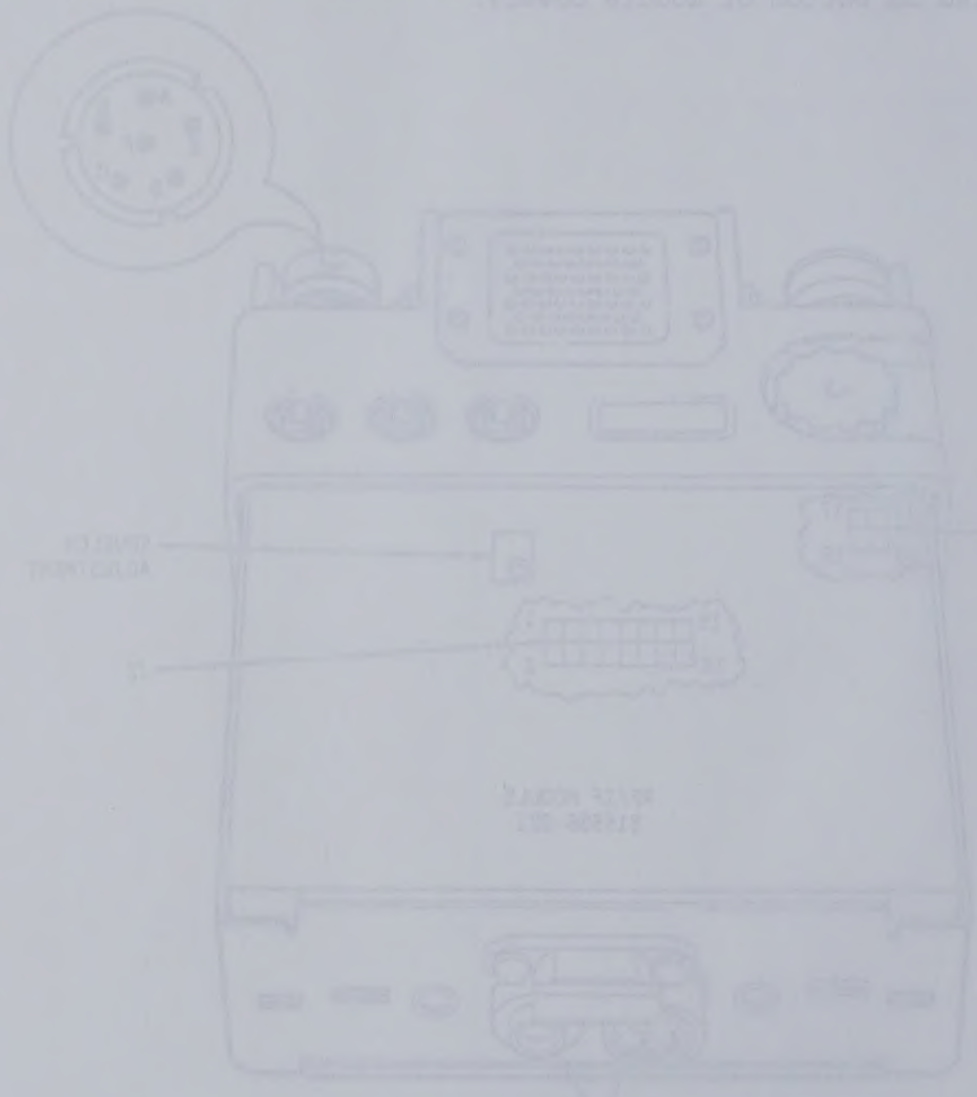


Figure 5-3. Radio Set Component Locations Diagram (Sheet 1 of 2)



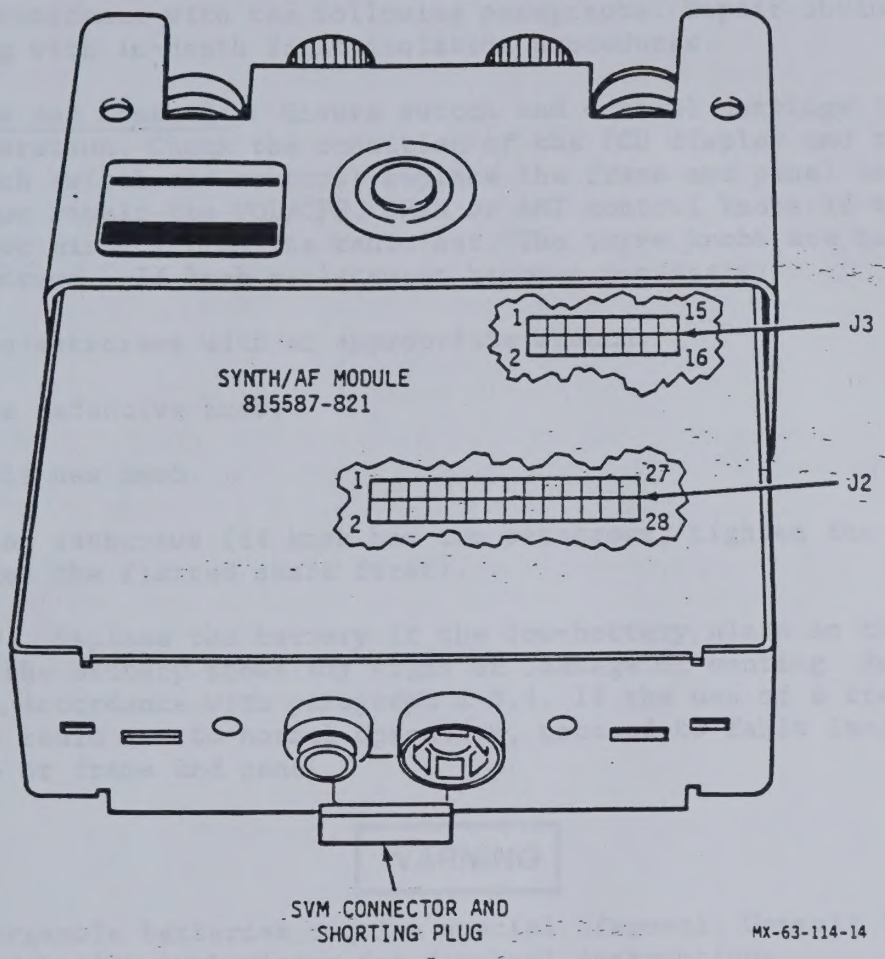


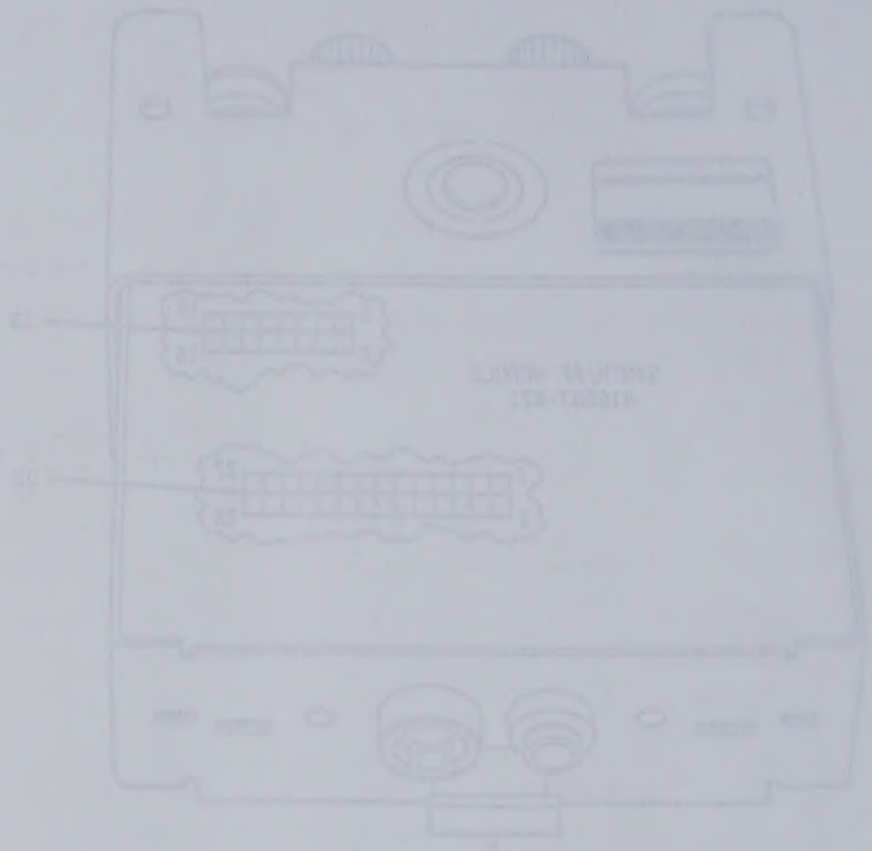
Figure 5-3. Radio Set Component Locations Diagram (Sheet 2 of 2)

NOTE

The squelch adjustment should not be made on a degraded channel (refer to table 3-3) as the result would be reduced sensitivity on nondegraded channels due to higher squelch threshold level.

c. Rotate squelch control on RF/IF module counterclockwise until noise is heard in the speaker.

d. Slowly adjust control clockwise until receiver quiets (no noise bursts), then advance control one half turn clockwise.



5-6 PHYSICAL INSPECTION.

If the radio set fails to operate properly, perform a physical inspection of each item in accordance with the following paragraphs. Repair obvious defects before proceeding with in-depth fault isolation procedures.

5-6.1 Switches and Controls. Ensure switch and control settings are correct for the desired operation. Check the condition of the LCD display and the mechanical function of each switch and control; replace the frame and panel assembly if defective. Replace or repair the VOL/OFF, CHAN or ANT control knobs if the knobs are broken, loose or missing from the radio set. The three knobs are held onto their shafts by setscrews. If knob replacement becomes necessary:

a. Loosen setscrews with an appropriate wrench.

b. Remove defective knob.

c. Install new knob.

d. Tighten setscrews (if knob has two setscrews, tighten the setscrew that engages the flatted shaft first).

5-6.2 Battery. Replace the battery if the low-battery alarm in the radio set is present or if the battery shows any signs of leakage or venting. Replace the radio set battery in accordance with paragraph 2-3.1. If the use of a fresh battery does not return the radio set to normal operation, proceed to fault isolate to the defective module or frame and panel.

WARNING

Non-rechargeable batteries require special disposal. Consult local safety and health authorities for disposal instructions.

Use care in handling batteries. Dropped or damaged batteries may develop an internal short. Do not short the battery terminals.

CAUTION

Remove any corrosion within the battery case prior to installing a new battery.

In order to prevent water seepage make sure battery case, latches and rubber gasket are not damaged. Make sure battery case and module cover are properly aligned before fastening latches.

5-6.3 Antenna. Check the antenna for cracks or corrosion. Remove any signs of corrosion. Replace the antenna if broken or missing. Remove the damaged antenna from connector by turning antenna counterclockwise. Insert new antenna into connector and finger tighten clockwise.

5-6.4 Connectors. Check radio set connectors for corrosion or thread damage. Remove any signs of corrosion. If a connector is loose, stripped or otherwise damaged, replace the frame and panel assembly.

5-6.5 Module Assemblies. To inspect the modules, remove the module cover from the rt unit by turning the two captive screws on the bottom of the module cover counterclockwise. Remove the RF/IF and SYNTH/AF modules in accordance with paragraph 5-8.2. Inspect modules for cracks, broken foil traces or cold solder connections. Closely inspect all board mounted components for shorts between adjacent component leads, broken or charred resistors or burned spots on PC boards. Inspect the module sockets for damage. A normal socket should have two spring leafs visible in each pin hole. If the leaf breaks off or is damaged inside the socket, the module should be replaced. Repair other obvious defects before continuing fault isolation procedures. If no defects are observed reinstall the RF/IF and SYNTH/AF modules (paragraph 5-8.2) to the rt unit and proceed to fault isolation.

CAUTION

If burned or charred spots are observed, do not attempt to fault isolate by installing a known good spare module. Installing a good module may cause it to be damaged also.

5-6.6 Frame and Panel Assembly. Inspect the frame and panel for broken traces in the flex cable or for bent or broken pins in the frame connectors. Ensure the battery connector is in good condition and the SVM shorting plug is installed in the SVM connector in the bottom of the frame. To prevent water seepage, check the rubber gaskets in the panel assembly to make sure they are not missing, cracked or damaged.

5-6.6.1 Connector Pins. When inspecting for bent connector pins, the pins should appear to be reasonably vertical in relation to the connector surface. Bent pins usually result when excessive prying force is applied to only one end or side of a module. The thumb of the opposite hand should always be used to stop the module travel and oppose the prying force. To straighten bent pins, use needle-nose or long-nose pliers with smooth jaws. Position the jaws so that the whole pin is straightened simultaneously (see figure 5-4).

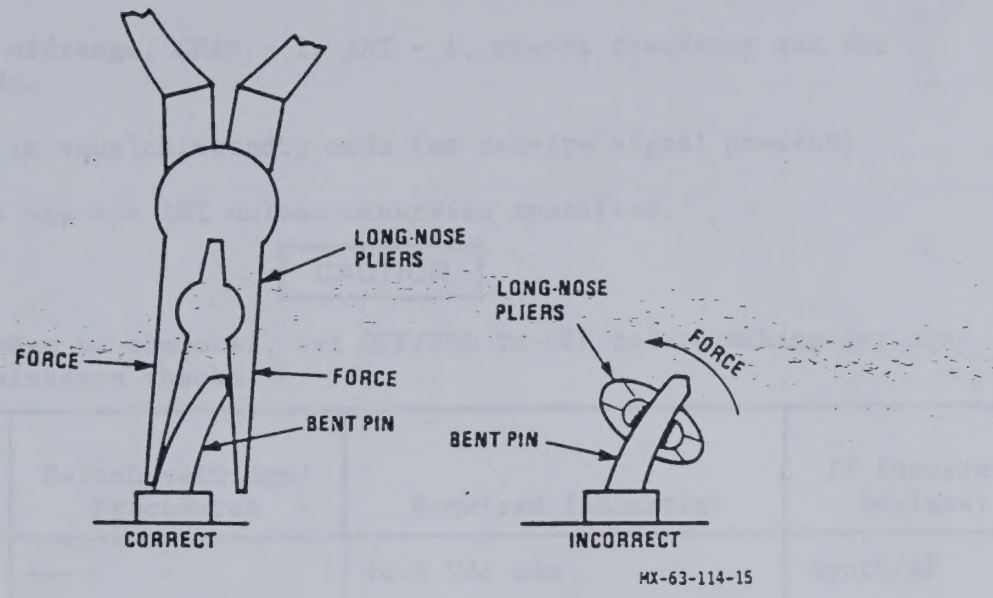


Figure 5-4. Pin Straightening Procedure

5-7 TROUBLESHOOTING.

When a fault is detected in the radio set during the direct support maintenance procedures (table 5-3), the fault isolation column of the procedure will indicate the most likely defective assembly, reference an adjustment procedure, or reference additional optional fault isolation checks per table 5-4.

5-7.1 Fault Isolation Checks (Optional). The following checks are included in this manual for the case where spare modules or frame/panel assys may not be available and a safer verification of defective subassy is desired. With only 3 replaceable items (RF/IF module, Synth/AF module and frame/panel assy) it is more effective to selectively change subassys, if they are readily available. Table 5-4 contains fault isolation checks referenced from the maintenance procedure (table 5-3). To use table 5-4, locate the connector-pin number in the POINT OF TEST column that is referenced in table 5-4. Set the radio set operating controls per the setup conditions as indicated in table 5-4 and perform the checks listed for that pin. Refer to figure 5-3 as necessary for connector and pin locations. By using these checks and the associated test equipment, the radio set may be more accurately fault isolated to a defective module or frame/panel.

5-7.2 Test Point Access. To gain access to the J2 and J3 connector pins, it is necessary to remove the metal cover from the top of the circuit card assemblies.

Table 5-4. Fault Isolation Checks

Preliminary Setup Conditions:

a. OFF/VOL - midrange, CHAN - 1, ANT - A, preset frequency set for 30.025 MHz.

b. Radio set in squelch/standby mode (no receive signal present).

c. Tolerances are +/- 10% unless otherwise specified.

CAUTION

To prevent damage to ohmmeter, set OFF/VOL to OFF before making any continuity or resistance checks.

Point of Test	Test Equipment	Switch settings/ Procedures	Required Indication	If incorrect, Replace:
J2-1	DC Voltmeter	----	+0.5 Vdc max.	Synth/AF
J2-2	RF Voltmeter	---- Press PUSH TO TALK	RF signal absent. 300 mV RF signal present.	Synth/AF Synth/AF
J2-3	DC Voltmeter	---- Press PUSH TO TALK	+5.0 Vdc +0.5 Vdc max.	Synth/AF Synth/AF
J2-4	Scope	----	12 Vp-p min. pulsed DC. 210 msec repeat rate.	Synth/AF
	DC Voltmeter	Jumper J2-6 to GND Press PUSH TO TALK	+12 Vdc min. +0.5 Vdc max.	Synth/AF Synth/AF
J2-5	Scope	----	1.0 Vp-p receiver noise	RF/IF
J2-6	DC Voltmeter	----	+5.0 Vdc	RF/IF
J2-7	Scope	---- Press PUSH TO TALK	+12 Vp-p min. pulsed DC. +0.5 Vdc max.	Synth/AF Synth/AF Synth/AF
J2-8	DC Voltmeter	----	+5.0 Vdc	

Table 5-4. Fault Isolation Checks-Continued

Point of Test	Test Equipment	Switch settings/ Procedures	Required Indication	If incorrect, Replace:
J2-9	DC Voltmeter	----	2 Vdc*	Synth/AF
		CHAN - 3	4 Vdc	Synth/AF
		CHAN - 4	7 Vdc	Synth/AF
		CHAN - 6	10 Vdc	Synth/AF
		CHAN - 7	2 Vdc	Synth/AF
		CHAN - 9	6 Vdc	Synth/AF
		CHAN - 10	10 Vdc	Synth/AF
J2-10	DC Voltmeter	----	+0.5 Vdc max.	Synth/AF
		Press PUSH TO TALK	+12 Vdc min.	Synth/AF
J2-11	Ohmmeter	----	Continuity - chassis GND.	Frame/Panel
		----	Continuity - AUDIO pin A.	Frame/Panel
J2-12	DC Voltmeter	----	+12 Vdc min.	Frame/Panel
J2-13	Scope	----	100 mV RF signal riding on 7.0 Vdc.	RF/IF
J2-14	DC Voltmeter	----	+12 Vdc min.(below 51mHz)	Synth/AF
		----	+0.5 Vdc max.(above 51mHz	Synth/AF
J2-15	Ohmmeter	----	Continuity - chassis GND.	Synth/AF
J2-16	DC Voltmeter	----	+0.5 Vdc max.(below 51mHz)	Synth/AF
		----	+12 Vdc min.(above 51 mHz)	
J2-17	Ohmmeter	----	Continuity - AUDIO pin B.	Frame/Panel
	Scope	----	Audio signal absent.	Synth/AF
		Unmatched antenna SW position.	Antenna warning signal present. Level varies with VOL control setting.	Synth/AF
J2-18	Ohmmeter	----	Continuity - J2-22.	Frame/Panel

*For other preset frequencies the following voltages apply:

37.025	4 Vdc
46.025	7 Vdc
53.975	10 Vdc
54.025	2 Vdc
70.025	4 Vdc
83.975	10 VDc

Table 5-4. Fault Isolation Checks-Continued

Point of Test	Test Equipment	Switch settings/ Procedures	Required Indication	If incorrect, Replace:
J2-19	Ohmmeter	----	Continuity - AUDIO pin C.	Frame/Panel
	DC Voltmeter	----	+4.5 Vdc	Synth/AF
J2-20	DC Voltmeter	----	+5.0 Vdc	Synth/AF
	Scope	Press PUSH TO TALK	5.0 Vp-p, 150 Hz square wave signal present.	Synth/AF
J2-21	Ohmmeter	----	Continuity - AUDIO pin D.	Frame/Panel
J2-22	Scope	Press PUSH TO TALK	6.0 Vp-p voice signal present when speaking into MIC.	Synth/AF
J2-23	Ohmmeter	----	500k ohms min. to GND.	Frame/Panel
		Press SQ DSBL	Continuity - chassis GND.	Frame/Panel
J2-24	Ohmmeter	VOL - full CCW to full CW	Resistance to GND varies smoothly from 100k ohms to 20 ohms max.	Frame/Panel
J2-25	Ohmmeter	----	10 ohms max. to GND.	Frame/Panel
J2-26	Ohmmeter	----	100k ohms to GND.	Frame/Panel
J2-27	Ohmmeter	----	500k ohms min. to GND.	Frame/Panel
		Press PUSH TO TALK	10 ohms max. to GND.	Frame/Panel
J2-28	Ohmmeter	----	Continuity - J2-5.	Frame/Panel
J3-1	Ohmmeter	----	500k ohms min. to GND.	Frame/Panel
		Press INC	Continuity - chassis GND.	Frame/Panel
J3-2	Ohmmeter	----	500k ohms min. to GND.	Frame/Panel
		Press SET	Continuity - chassis GND.	Frame/Panel
J3-4	Ohmmeter	CHAN - 6	Continuity - J3-5.	Frame/Panel
		CHAN - 7	Continuity - J3-3.	Frame/Panel
		CHAN - 8	Continuity - J3-7.	Frame/Panel
		CHAN - 9	Continuity - J3-9.	Frame/Panel
		CHAN - 10	Continuity - J3-11.	Frame/Panel
J3-6	Scope	----	4.0 Vp-p serial data stream present.	Synth/AF

Table 5-4. Fault Isolation Checks-Continued

Point of Test	Test Equipment	Switch settings/ Procedures	Required Indication	If incorrect, Replace:
J3-8	Ohmmeter	----	Continuity - J3-11.	Frame/Panel
		CHAN - 2	Continuity - J3-9.	Frame/Panel
		CHAN - 3	Continuity - J3-7.	Frame/Panel
		CHAN - 4	Continuity - J3-3.	Frame/Panel
		CHAN - 5	Continuity - J3-5.	Frame/Panel
J3-10	Scope	----	4.0 Vp-p clock signal stream present.	Synth/AF
J3-12	DC Voltmeter	----	+5.0 Vdc	Synth/AF
J3-13	Ohmmeter	----	Momentary deflection, then 500k ohms min. to GND.	Frame/Panel
		----	3.0k ohms to J3-11.	Frame/Panel
		ANT - B	3.0k ohms to J3-9.	Frame/Panel
		ANT - C	3.0k ohms to J3-7.	Frame/Panel
		ANT - D	3.0k ohms to J3-5.	Frame/Panel
		ANT - E	3.0k ohms to J3-3.	Frame/Panel
J3-14	Ohmmeter	----	Continuity - AUDIO pin F.	Frame/Panel
J3-16	Ohmmeter	----	10k ohms to ANT.	Frame/Panel
		----	Momentary deflection, then 500k ohms min. to GND.	
J3-17	Ohmmeter	----	1.5k ohms to J3-13.	Frame/Panel
		ANT - 50	Momentary deflection, then open to ANT.	Frame/Panel
J3-18	Ohmmeter	----	1.5k ohms to J3-13.	Frame/Panel
		ANT - 50	Momentary deflection, then open to ANT.	Frame/Panel
J3-19	Ohmmeter	----	Continuity - chassis GND.	Frame/Panel
J3-20	Ohmmeter	----	Continuity - chassis GND.	Frame/Panel

Table 5-5. Description of Maintenance Kit MK-2137/PRC-68

Item no.	Part no.	Name	Use
1	914877-801	Audio adapter assembly	Provides means of keying transmitter and interfacing test equipment through the audio connector on the radio set.
2	565460-801	Power cable assembly	Provides regulated 15 ±0.5 vdc to radio set from external power supply (20 to 30 vdc).
3	565461-801	RF cable assembly	Provides means of connecting test equipment to the test points on the radio set circuit board.
4	914876-801	RF attenuator assembly	Provides means of connecting wattmeter and frequency counter to radio set.
5	565462-801	Jumper plug assembly	(Not used with radio set AN/PRC-126).
6	565462-802	Jumper plug assembly	(Not used with radio set AN/PRC-126).
7	914598-801	Antenna adapter	Provides means of connecting antenna of radio set to test equipment.
8	914878-801	150 Hz filter assembly	Provides filtering of 150 Hz squelch tone during distortion tests.
9	565463-801	Test lead assembly	Provides means of connecting digital voltmeter for voltage checks on radio set printed circuit board.

5-8 REPAIR.

After a fault is isolated to a defective assembly, repair the radio set as outlined in the following procedures. Repair of the radio set consists of disassembly, replacement of defective items found during physical inspection (paragraph 5-6) or troubleshooting (paragraph 5-7), and reassembly of the radio set.

5-8.1 Disassembly. Disassemble the radio set as follows:

a. Unfasten latches on battery case and remove the battery case and battery (if installed).

b. Remove module cover by turning the two captive screws counterclockwise (located on bottom of module cover).

5-8.2 Removal and Replacement of Modules. The following procedure is used for removal and insertion of modules in the radio set. The RF/IF module is located on the SPKR/MIC side of the radio set. The SYNTH/AF module is located on the PTT switch side of the radio set.

CAUTION

The Synth/AF and RF/IF modules are subject to damage by static electricity. Observe precautions for handling electrostatic sensitive devices (ESD) as outlined in TO 00-25-234.

a. Hold the radio set in the palm of one hand and grip the module with the thumb and forefinger of the other hand. Fingerholds are provided on the module through open areas in the radio set frame. Gently rock the module and pull straight out from the frame.

b. Align the frame connector(s) pins with the module mating sockets and gently push the module straight into the frame until the module housing is seated on the frame divider plate.

5-8.3 Reassembly. Reassemble the radio set as follows:

a. Apply a thin coat of silicone grease (item 5, table 1-2) to top edge of the module cover.

b. Slide module cover over rt unit and secure with the two captive screws located on the bottom of the cover (turn clockwise).

c. Plug battery into mating connector on bottom of rt unit.

d. Apply a thin coat of silicone grease (item 5, table 1-2) to the top edge of the battery case.

e. Replace battery case and secure with the two latches.

5-9 PLACING IN SERVICE.

After the radio set has been repaired, the operational checkout procedure of paragraph 5-4 shall be repeated to verify radio set operation.

5-10 PACKAGING OF REPLACEABLE ASSEMBLIES.

Package the defective assembly in the same packaging material in which the spare was packed at the time of receipt. If the original container is not available, pack the item in accordance with figure 5-5.

CAUTION

The Synth/AF and RF/IF modules contain electrostatic sensitive devices. Refer to TO 00-25-234 for correct handling and packaging instructions.

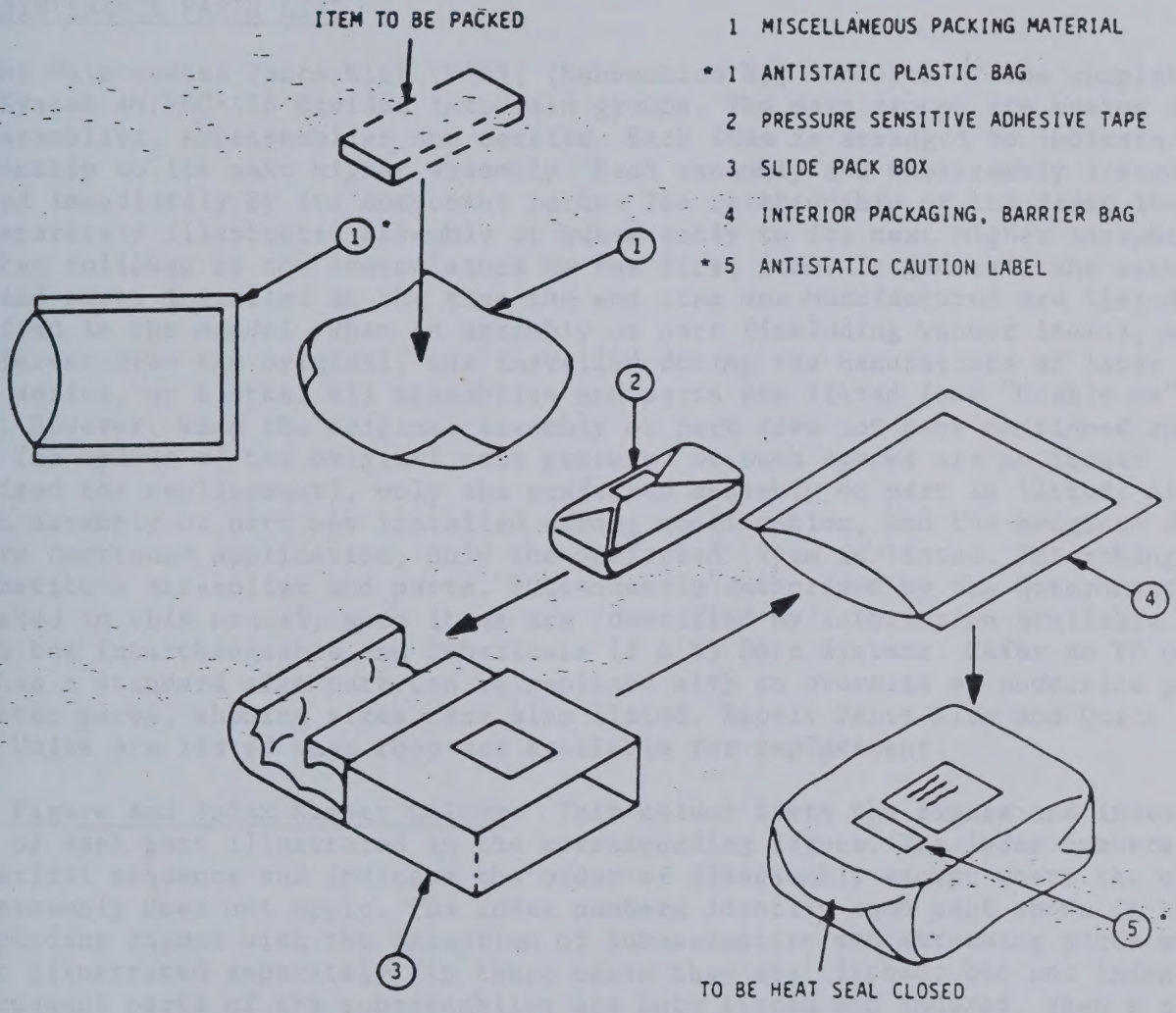
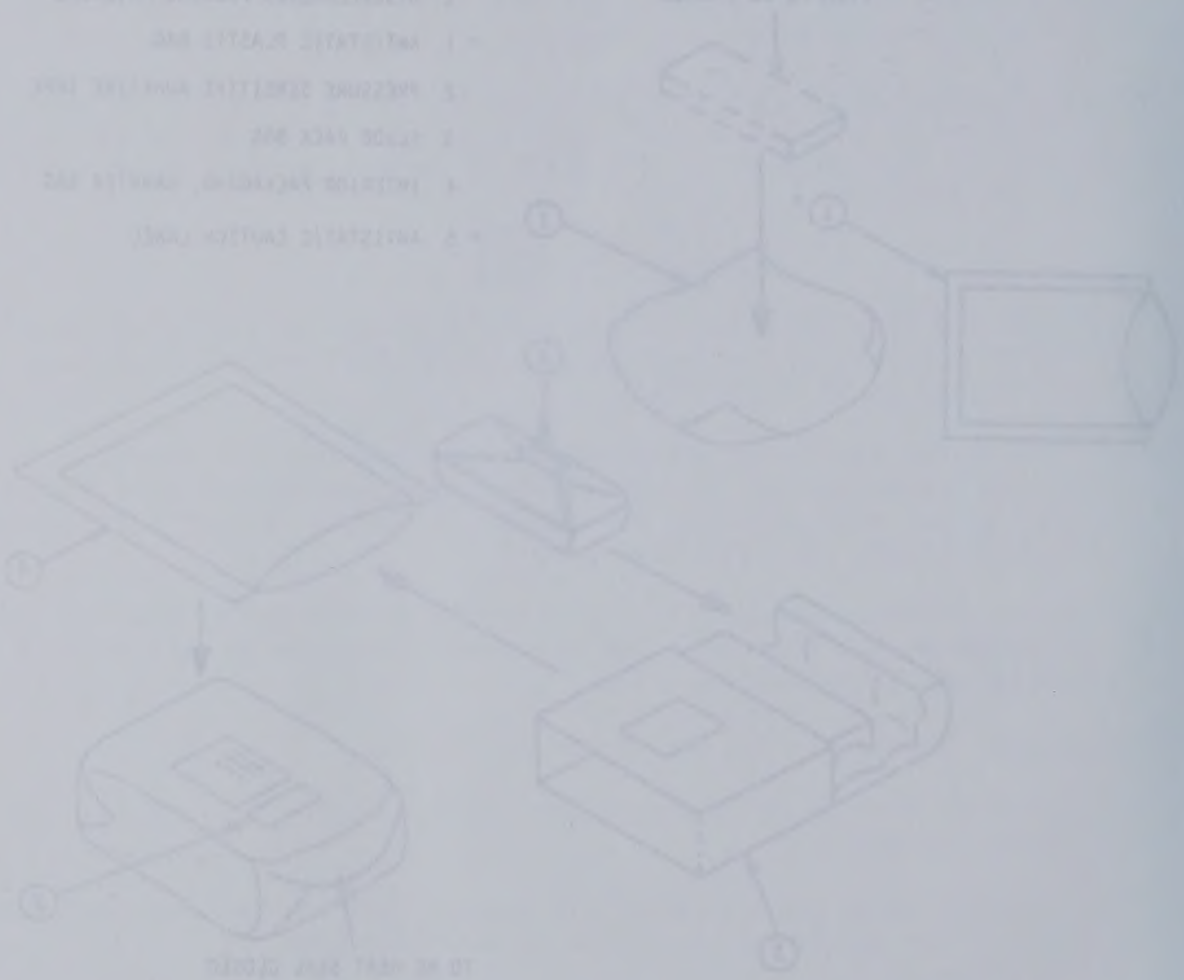

ITEM TO BE PACKED
1 MISCELLANEOUS PACKING MATERIAL
* 1 ANTISTATIC PLASTIC BAG
2 PRESSURE SENSITIVE ADHESIVE TAPE
3 SLIDE PACK BOX
4 INTERIOR PACKAGING, BARRIER BAG
* 5 ANTISTATIC CAUTION LABEL
TO BE HEAT SEAL CLOSED
* USE ANTISTATIC PLASTIC BAG AND CAUTION LABEL FOR THE SYNTH/AF AND RF/IF ASSEMBLIES.
MX-63-114-16

Figure 5-5. Replaceable Assemblies Packaging Diagram



SECTION VI

ILLUSTRATED PARTS BREAKDOWN

SUBSECTION A - INTRODUCTION

6-1 GENERAL.

This illustrated parts breakdown lists, illustrates and describes the parts used in Radio System AN/PRC-126 manufactured by the Magnavox Government and Industrial Electronics Company in Fort Wayne, Indiana.

6-2 MAINTENANCE PARTS LIST.

The Maintenance Parts List (MPL), (Subsection B), consists of the complete Radio System AN/PRC-126 divided into main groups. The main groups are broken down into assemblies, subassemblies and details. Each item is arranged to indicate its relationship to its next higher assembly. Each assembly and subassembly listed is followed immediately by its component parts. The relationship of the first item of each separately illustrated assembly or subassembly to its next higher assembly is indicated followed by the nomenclature to the first item. In general, the assemblies and parts installed at the time the end item was manufactured are listed and identified in the manual. When an assembly or part (including vendor items), which is different from the original, was installed during the manufacture of later items, series, or blocks, all assemblies and parts are listed (and "Usable on" coded). However, when the original assembly or part does not have continued application (no spares of the original were procured or such spares are no longer authorized for replacement), only the preferred assembly or part is listed. Also, when an assembly or part was installed during modification, and the original does not have continued application, only the preferred item is listed. Interchangeable and substitute assemblies and parts, subsequently authorized by the Government, are not listed in this manual; such items are identified by information available through the Interchangeable and Substitute (I & S) Data Systems. Refer to TO 00-25-184. When a standard size part can be replaced with an oversize or undersize part, the latter parts, showing sizes, are also listed. Repair Parts Kits and Quick Change Units are listed when they are available for replacement.

6-2.1 Figure and Index Number Column. This column lists the figure and index number of each part illustrated in the corresponding figure. The index numbers are in numerical sequence and indicate the order of disassembly except where the order of disassembly does not apply. The index numbers identify each part shown in the corresponding figure with the exception of subassemblies and attaching parts which are not illustrated separately. In these cases they are listed; but not indexed. The component parts of the subassemblies are both listed and indexed. When a group of parts (bolt, washer, nut) is used at a specific location for attachment purposes, one index number appears on the same line as the first part composing the group.

6-2.2 Part Number Column. This column lists the contractor's drawing number, including dash number, assigned to each part and vendor part numbers of parts used by the contractor exactly as produced by the respective vendor. Those parts which have Government Standards numbers assigned to them have the Government Standards

number listed. Parts altered or selected for special fit, tolerance, etc., from vendor, commercial or government standard items have contractor part numbers: The vendor, commercial or Government Standards part number of the altered or selected part follow the part description in the Description column.

6-2.3 FSCM Column. This column list a 5-digit code number denoting the vendor from whom the part may be procured is shown following the part number. The source of vendor code numbers is the Federal Supply Code for Manufacturers (FSCM) Cataloging Handbook H4-1, H4-2 and H4-3.

6-2.4 Description Column. This column contains the description of all items appearing on the Maintenance Parts List. The indentation headed "1" through "7" in this column shows the relationship of parts and subassemblies to assemblies. The description consists of the approved item name, as found in the Federal Item Identification Guide for Supply Cataloging Handbook H6-1, or are in accordance with the contractor's drawing title, plus modifiers that are necessary to identify the particular item. Additional information may follow the item description and list of alternate part numbers, as required to give stock ordering information, exceptions to the Usable On Code for the item, references to preceding and subsequent figures concerning assemblies and subassemblies, etc. This data is to be considered an integral part of the item description to ensure the correctness of repair and maintenance procedures. Item(s) identified as a Hardness Critical Item (HCI), the marking HCI (reference DOD-/STD-100) shall precede the first word in the Description column.

6-2.5 Attaching Parts. These are used to attach parts or assemblies to each other and are listed immediately after the part to be attached. The attaching parts have the same indentation code as the parts attached. The code (AP) appears on the same line with and immediately following the item identified as an attaching part.

6-2.6 Units Per Assembly. This column contains the number of units required per assembly and/or subassembly. If more than one assembly is required, the total number of assemblies is listed. When an assembly or subassembly is listed more than once, the total number of units per assembly or subassembly appears the first time and REF for subsequent listings.

6-2.7 Usable On Code. This column shows the Usable On Codes for systems, assemblies and parts to indicate specific usability by part number. Explanations of the usable on codes are provided at the bottom of the applicable page. The codes A, B, C etc., when shown within a group, relate the part back to the same coded part within the next higher assembly. When this column is left blank, an assembly or part is common to all part number variations of the next higher assembly.

6-2.8 Source, Maintenance and Recoverability SMR Codes. (Not applicable) This manual contains Joint Military Services SMR Codes. Detailed coding criteria may be obtained from TO 00-25-195.

6-3 NUMERICAL INDEX. (Not applicable)

The Numerical Index (Subsection C) is compiled in accordance with the numerical part number filing system described in the following paragraphs.

6-3.1 Part Number Column. This column contains all the part numbers that appear in the Maintenance Parts List and part numbers that have been assigned to detail parts assembled into the end article. The order of procedure establishing the sequence in which the part numbers are listed is explained below. The order of precedence in the first position of each part number is Letters A through Z, Numerals 0 through 9.

NOTE

Alphabetical 0's are considered as numerical zeroes in all positions in each part number.

The order of precedence in the second and succeeding positions in each part number is as follows:

(1) Space (blank column).
(2) Diagonal (/).
(3) Period (.).
(4) Dash (-).
(5) Letters A through Z.
(6) Numerals 0 through 9.

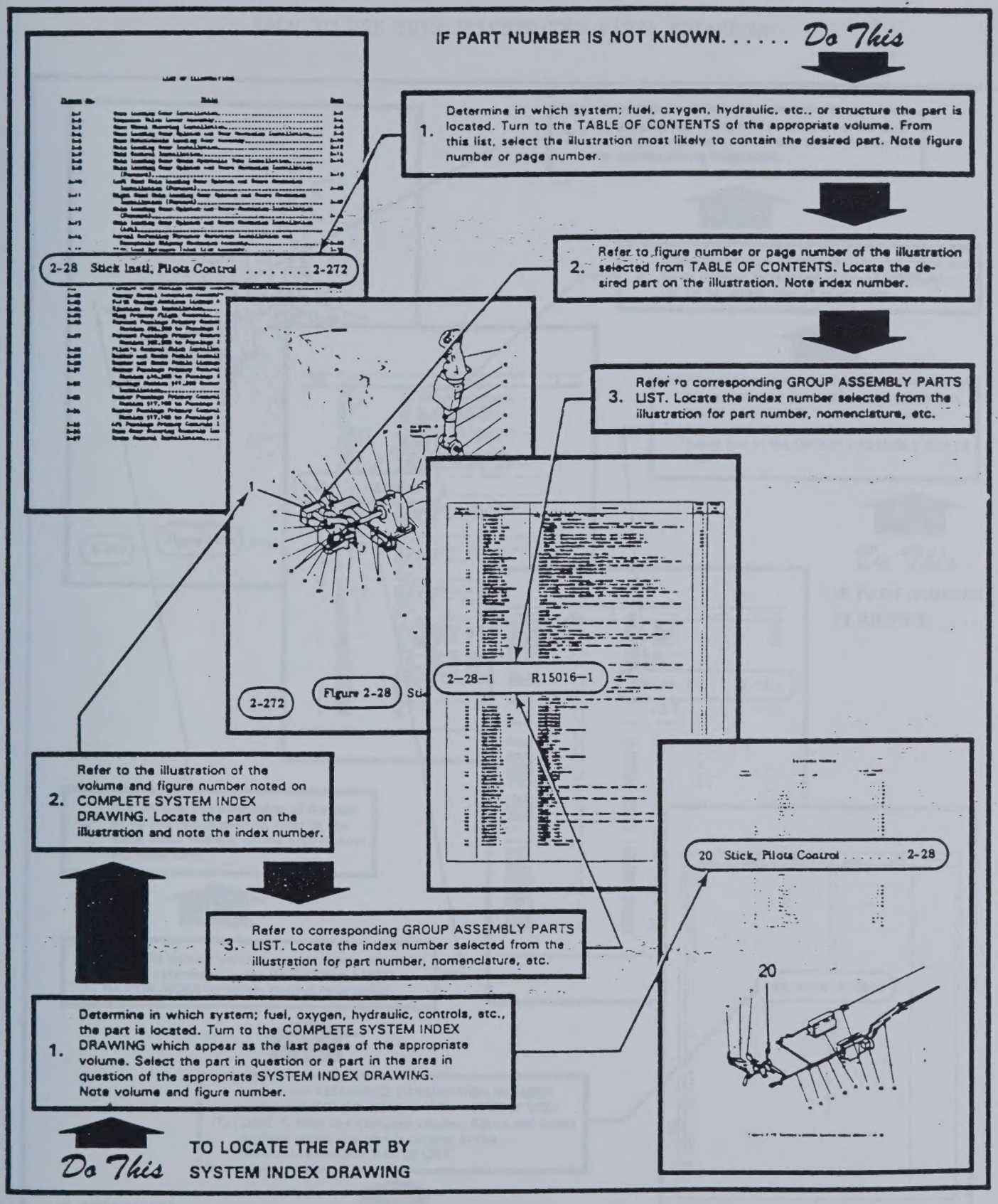
The following is a sample of part numbers arranged in sequence used in the Numerical Index.

AN931-4-13	B2	16.W2
A2460	S/1	16W060
A317	1140	32P010-1
A32	121873	32P0101
B12	128	39A46

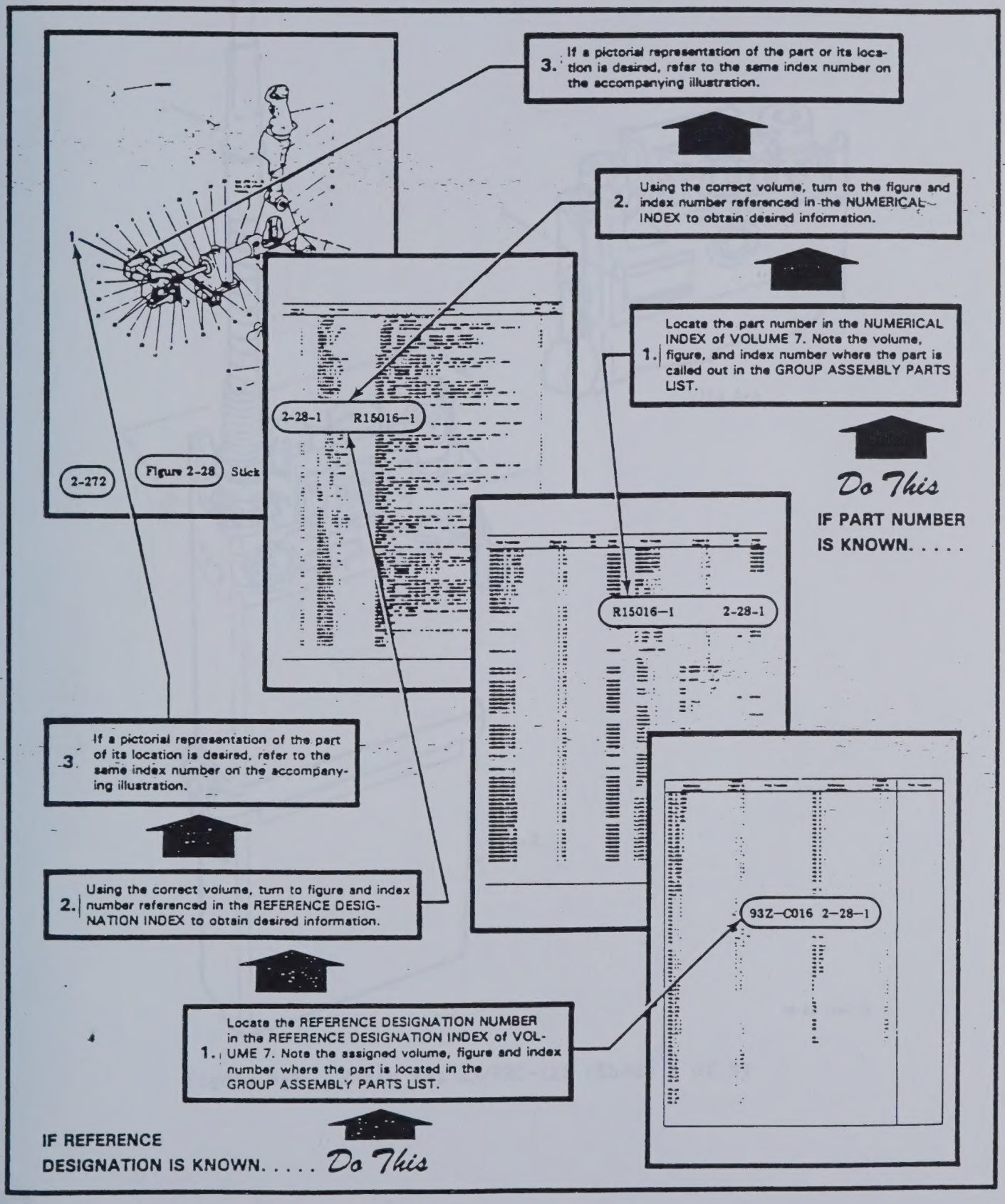
6-3.2 Figure and Index Number Column. For each part number, the figure or figure and index number refers to the Maintenance Parts List where parts relationship is shown. For government standard parts and contractor standard parts only, the first figure and index number that occurs will be listed. When an assembly or part has not been assigned an index number, the figure and index number of the preceding part in the Maintenance Parts List is used with the letter "F" before the figure number, such as F7-6. The letter "F" denotes "follows".

6-4 REFERENCE DESIGNATION INDEX. (Not applicable)

The Reference Designation Index (Subsection D) lists, in alphabetical-numerical order, the reference designations used in schematic diagrams and instruction books. Opposite the reference designation is listed the figure index number as shown in the Maintenance Parts List.


IF PART NUMBER IS NOT KNOWN. . . . . Do This
1. Determine in which system; fuel, oxygen, hydraulic, etc., or structure the part is located. Turn to the TABLE OF CONTENTS of the appropriate volume. From this list, select the illustration most likely to contain the desired part. Note figure number or page number.
2-28 Stick Instl, Pilots Control 2-272
2. Refer to figure number or page number of the illustration selected from TABLE OF CONTENTS. Locate the desired part on the illustration. Note index number.
3. Refer to corresponding GROUP ASSEMBLY PARTS LIST. Locate the index number selected from the illustration for part number, nomenclature, etc.
2-272
Figure 2-28
2-28-1 R15016-1
2. Refer to the illustration of the volume and figure number noted on COMPLETE SYSTEM INDEX DRAWING. Locate the part on the illustration and note the index number.
3. Refer to corresponding GROUP ASSEMBLY PARTS LIST. Locate the index number selected from the illustration for part number, nomenclature, etc.
20 Stick, Pilots Control 2-28
20
1. Determine in which system; fuel, oxygen, hydraulic, controls, etc., the part is located. Turn to the COMPLETE SYSTEM INDEX DRAWING which appear as the last pages of the appropriate volume. Select the part in question or a part in the area in question of the appropriate SYSTEM INDEX DRAWING. Note volume and figure number.
Do This
TO LOCATE THE PART BY SYSTEM INDEX DRAWING

HOW TO USE THIS ILLUSTRATED PARTS BREAKDOWN


3. If a pictorial representation of the part or its location is desired, refer to the same index number on the accompanying illustration.
2. Using the correct volume, turn to the figure and index number referenced in the NUMERICAL INDEX to obtain desired information.
1. Locate the part number in the NUMERICAL INDEX of VOLUME 7. Note the volume, figure, and index number where the part is called out in the GROUP ASSEMBLY PARTS LIST.
Do This
IF PART NUMBER IS KNOWN. . . . .
2-272
Figure 2-28 Stick
2-28-1 R15016-1
R15016-1 2-28-1
93Z-C016 2-28-1
3. If a pictorial representation of the part of its location is desired, refer to the same index number on the accompanying illustration.
2. Using the correct volume, turn to figure and index number referenced in the REFERENCE DESIGNATION INDEX to obtain desired information.
1. Locate the REFERENCE DESIGNATION NUMBER in the REFERENCE DESIGNATION INDEX of VOLUME 7. Note the assigned volume, figure and index number where the part is located in the GROUP ASSEMBLY PARTS LIST.
IF REFERENCE DESIGNATION IS KNOWN. . . . . Do This

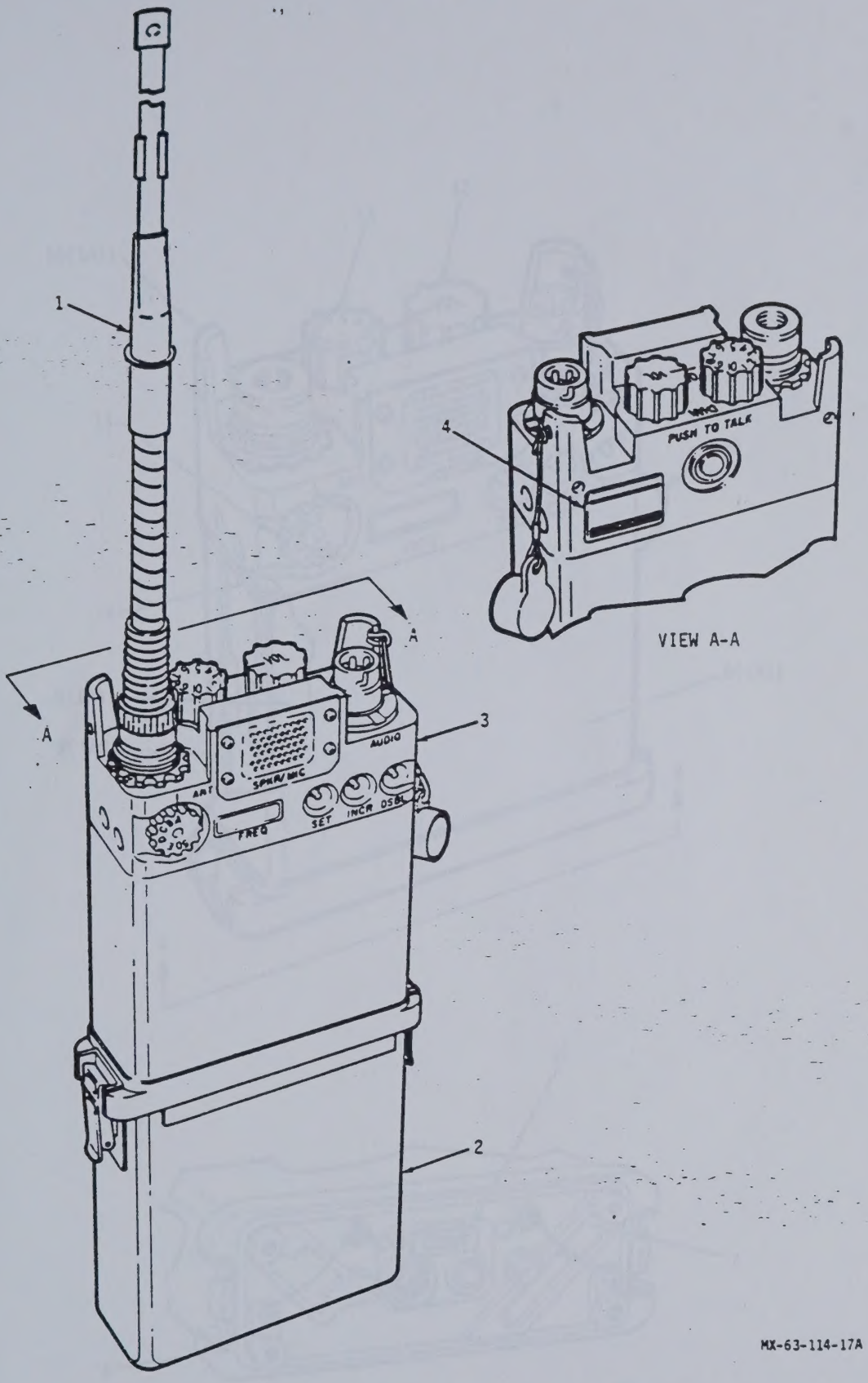
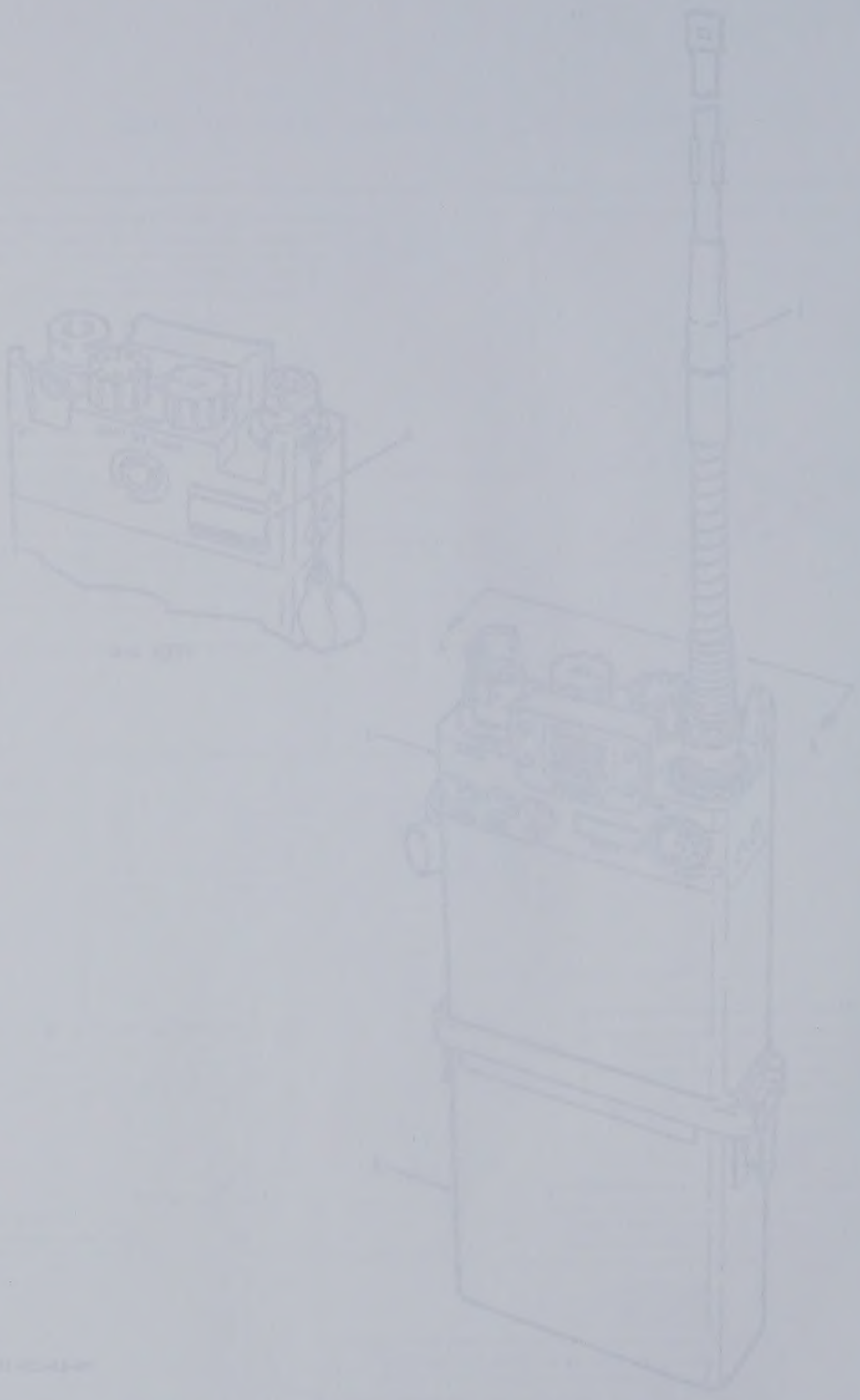


Figure 6-1. Radio Set AN/PRC-126 (Sheet 1 of 3)



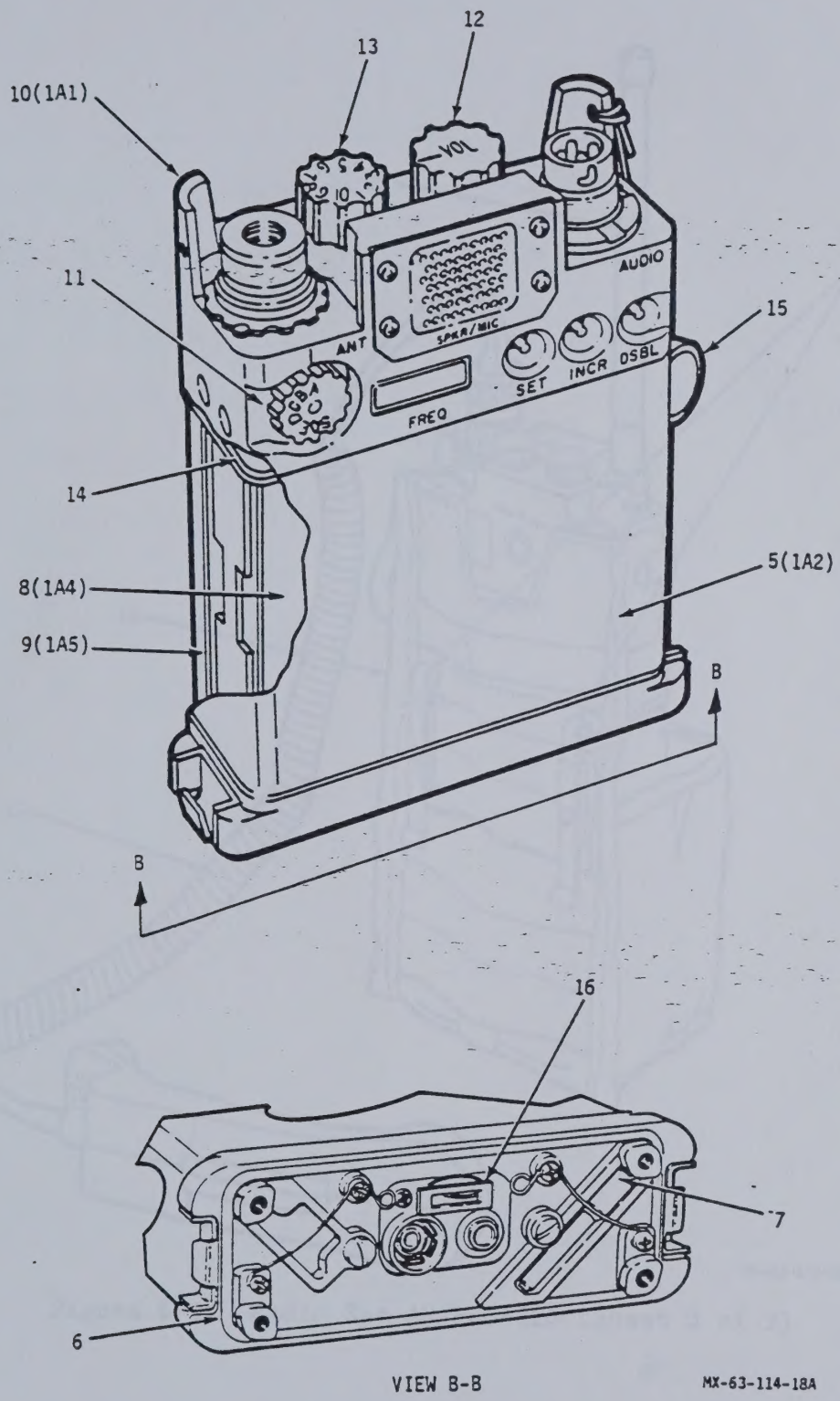
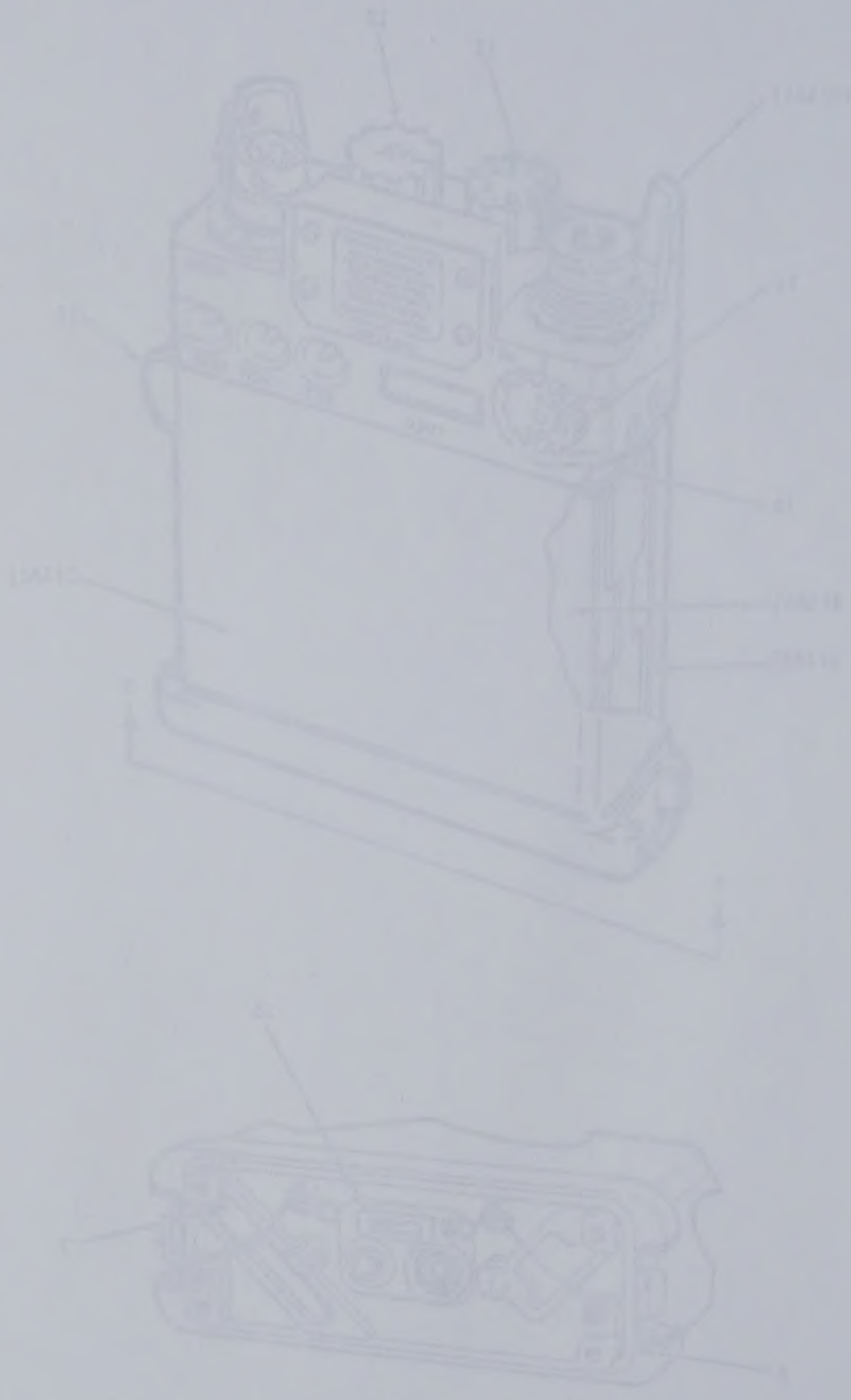


Figure 6-1. Radio Set AN/PRC-126 (Sheet 2 of 3)



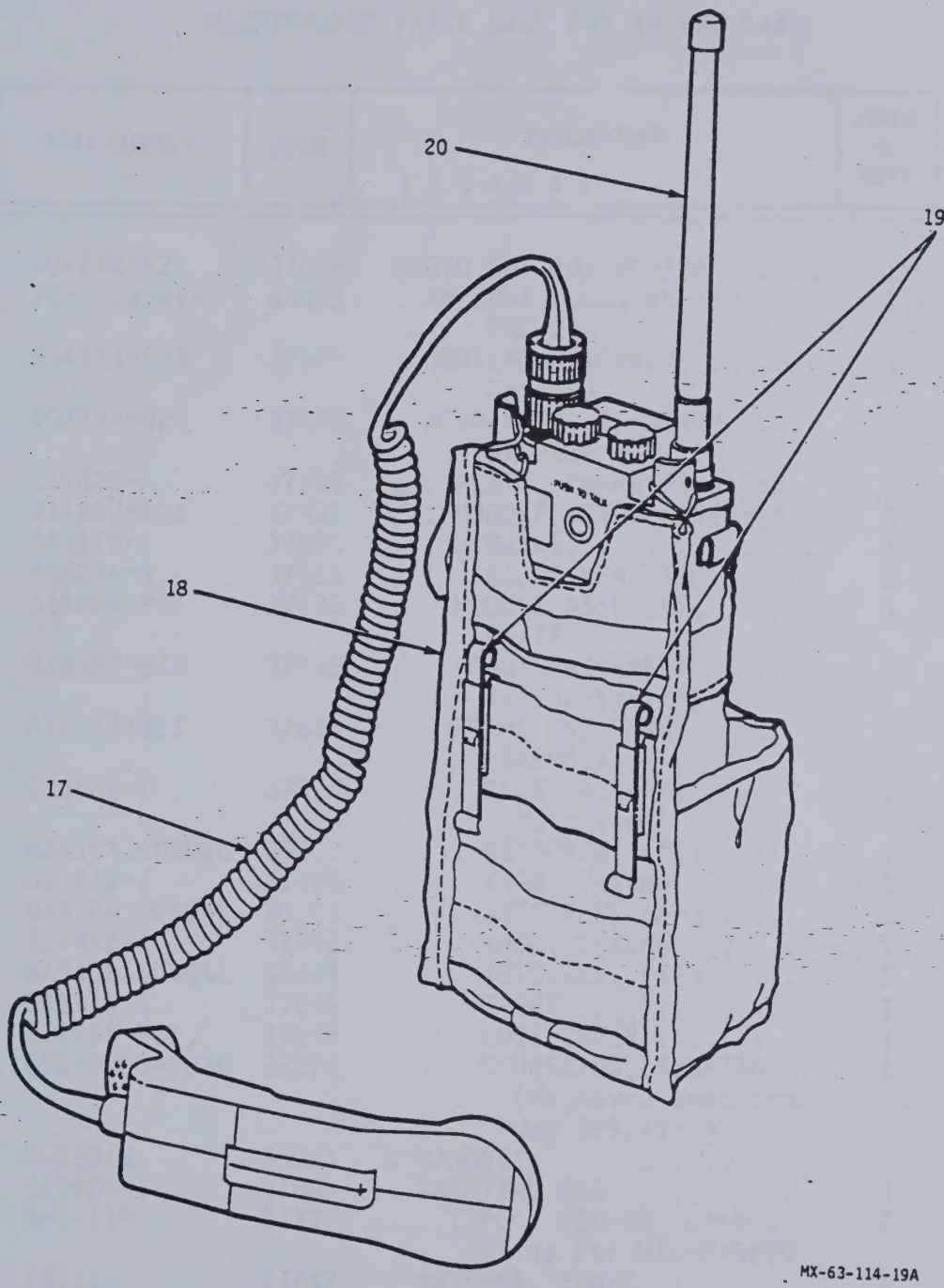


Figure 6-1. Radio Set AN/PRC-126 (Sheet 3 of 3)

SECTION VI

SUBSECTION B

MAINTENANCE PARTS LIST FOR AN/PRC-126

FIGURE AND INDEX NUMBER	PART NUMBER	FSCM	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE	SMR CODE
6-1-	707608-821	37695	RADIO SET AN/PRC-126	1		
- 1	SC-C-135894	80063	. ANTENNA, Long At-892/ ... PRC-25	1		
- 2	914153-805	37695	. HOUSING ASSEMBLY, ... Battery	1		
- 3	707594-821	37695	. RCVR/XMTR, RT-1547/ PRC-126	1		
- 4	159828-	37695	. . PLATE, Identification .	1		
- 5	918267-804	37695	. . MODULE COVER ASSEMBLY .	1		
- 6	345110-1	37695	. . . GASKET	1		
- 7	808234-1	37695	. . . ADJUSTMENT TOOL	1		
- 8	815586-821	37695	. . MODULE ASSEMBLY, ... RF/IF	1		
- 9	815587-821	37695	. . MODULE ASSEMBLY, ... Synthesizer/AF	1		
-10	816173-821	37695	. . FRAME AND PANEL ..... ASSEMBLY	1		
-11	516502-1	37695	. . . KNOB, Antenna ..... Matching	1		
	NAS1081C04D2L	80205	. . . SETSCREW, (AP)	2		
-12	517448-2	37695	. . . KNOB, Volume	1		
	NAS1081C04D4L	80205	. . . SETSCREW, (AP)	2		
-13	517448-1	37695	. . . KNOB, Channel	1		
	NAS1081C04D4L	80205	. . . SETSCREW, (AP)	2		
-14	345110-1	37695	. . . GASKET	1		
-15	817455-801	37695	. . . DUST COVER	1		
-16	095-9003-0024	98278	. . . CONNECTOR, SHORTING . (Magnavox spec cont dwg 185749-1)	1		
-17	H-250/U	80063	. HANDSET	1		
-18	349924-1	37695	. CARRYING BAG	1		
-19	4-1-139	81337	. . TYPE X KEEPER, with ... slide Per MIL-H-9890	2		
-20	10231	63747	. ANTENNA, Short ..... AS-4094/PRC-126 (Magnavox spec cont dwg 513250-2)	1		